



Disruptive Technology: An Uncertain Future

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21 May 2005

***Director of Plans & Programs
Defense Research and Engineering***

Report Documentation Page			<i>Form Approved OMB No. 0704-0188</i>	
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1. REPORT DATE 21 MAY 2005	2. REPORT TYPE	3. DATES COVERED 00-00-2005 to 00-00-2005		
4. TITLE AND SUBTITLE TechnologiesDisruptive Technology: An Uncertain Future			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Director of Plans & Programs, Defense Research and Engineering, Washington, DC			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. SUPPLEMENTARY NOTES Presented at the 6th Annual Science and Engineering Technology Conference/Tech Expo. held in Charleston, SC on 19-21 April 2005				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 62
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified		
19a. NAME OF RESPONSIBLE PERSON				



Future Battlespace



"Innovation within the armed forces will rest on experimentation with new approaches to warfare, strengthening joint operations, exploiting U.S. intelligence advantages, and taking full advantage of science and technology....."

The National Security Strategy of the United States, September 2002

Definition of Disruptive Technology

The Textbook Definition



- Harvard Professor, Clayton Christensen* described disruptive technologies as a lower-performance (but cheaper) new product that can be improved more rapidly, so that performance outpaces the product it is replacing
- Key concepts:
 - Greater performance than previous product
 - Replaces (drives) old product out of market

* “*The Innovator’s Dilemma*”, 1997

Disruptive Technology

The Non-Textbook Definition



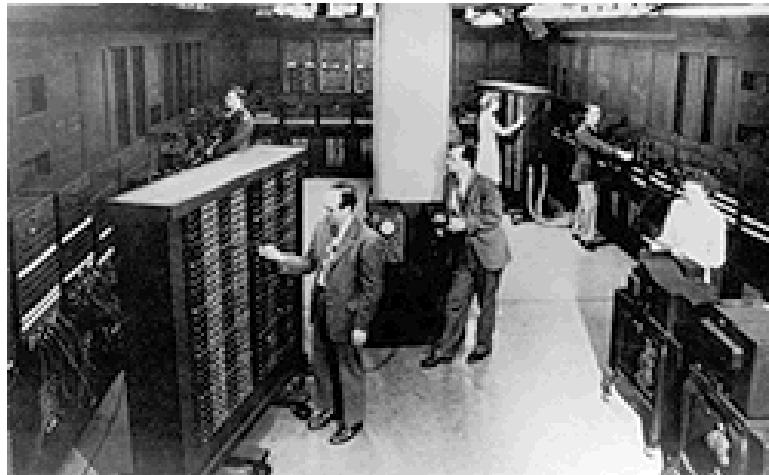
- For Defense systems, lower cost and lower initial performance does not matter
- What matters is rapid evolution from old, stable technology to new, dominating technology
- A technology surprise that gives a competitor an advantage
 - Business - Technology that overturns market
 - Military - Technology that causes a fundamental change in force structure, basing, and capability balance
- Disruptive Technologies may arise from systems or enabling technology

Definition of Disruptive Technology



Some Historical Examples--Commercial

Candle	→	Electric Light
Vacuum Tubes	→	Transistors
Mechanical Watches	→	Quartz Watches
Mainframe Computers	→	Personal Computers



In each case, the disruptive technology decimated the conventional market - in a very short time

Definition of Disruptive Technology



Some Historical Examples--Military

Spotter	→	Radar
Bombers	→	ICBMs
Horse Drawn Artillery	→	Armored Howitzers
Flares	→	Night Vision Goggles



In Each Case, the Disruptive
Technology Changed the Force Structure

A Focus on Revolutionary Advances



Stealth



Adaptive Optics and Lasers



GPS



Night Vision



Phased Array Radar



Definition of Disruptive Technology

Extended to the DoD



- For Military Application, a Disruptive Technology may be offensive, defensive, or “spin-off”
 - **Offensive** - A capability developed to provide a “transformational” new capability
 - **Defensive** - A capability developed in response to someone else’s advantage
 - **Unintended** - A capability developed for commercial....but with military applications

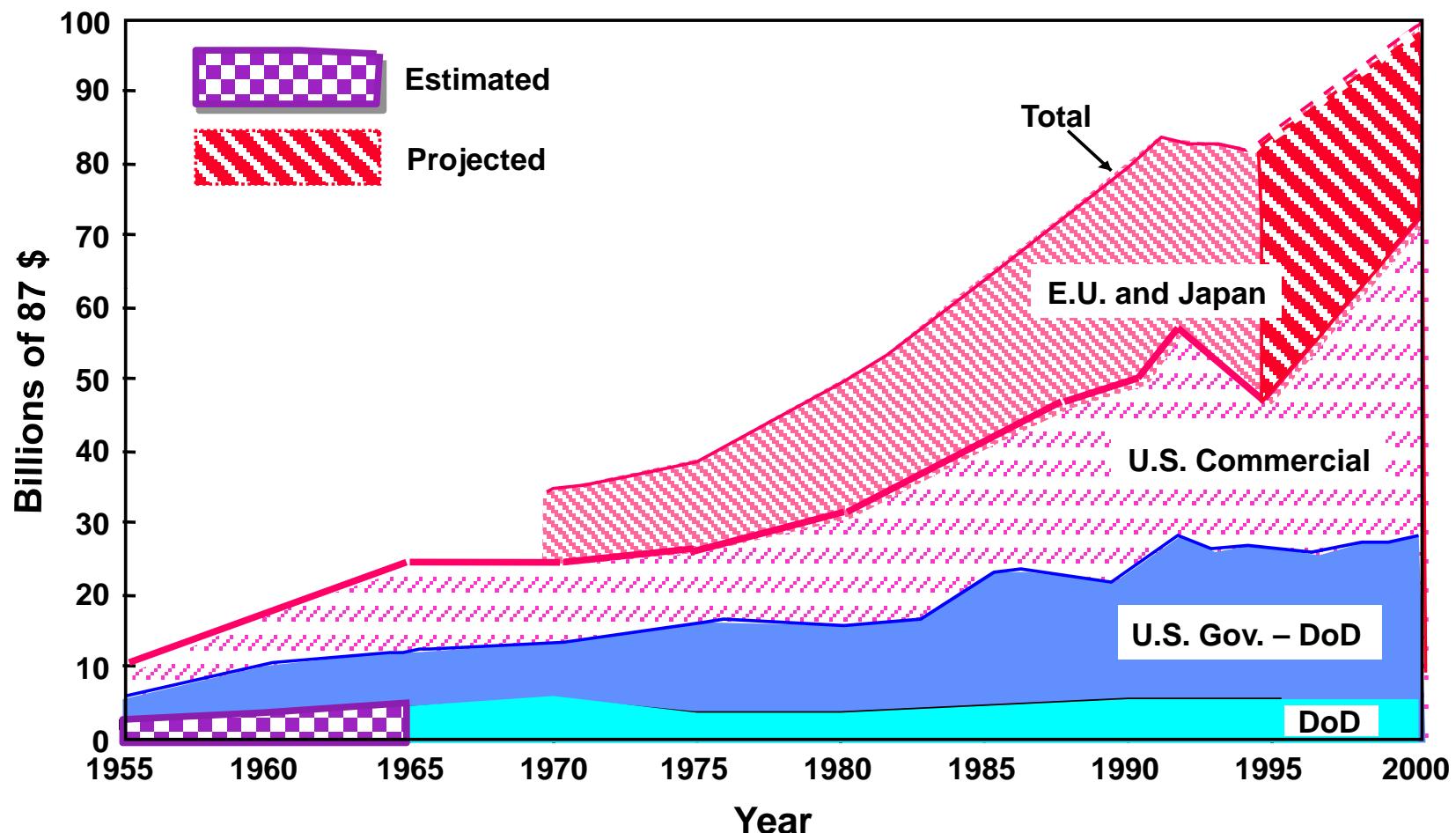
Disruptive Technologies

Frequently Take a Forcing Function



Technology	Approximate Date Of First Lab Demo	Approximate Date of First Military Applications
Radio	1901	1914
Airplane	1903	
Vacuum Tube	1906	
Mechanized Tank	1916	
Liquid-Fueled Rockets	1922	1944
Radar*	1925	1939
Gas Turbine*	1935	1944
Digital Computer*	1943	1945
Ballistic Missile*	1944	
Nuclear Weapons*	1945	
Transistor*	1948	1957
Inertial Navigation*	1950	1955
Nuclear Propulsion*	1950	1954
Artificial Earth Satellites*	1957	1960
Integrated Circuit*	1960	1970
Laser*	1961	
Precision Weapons*	1965	
AI Expert System*	1965	

U.S. and Worldwide Research Base Since WWII



Source: Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers; June 2000; Data provided by the Organization for Economic Cooperation and Development & National Science Foundation

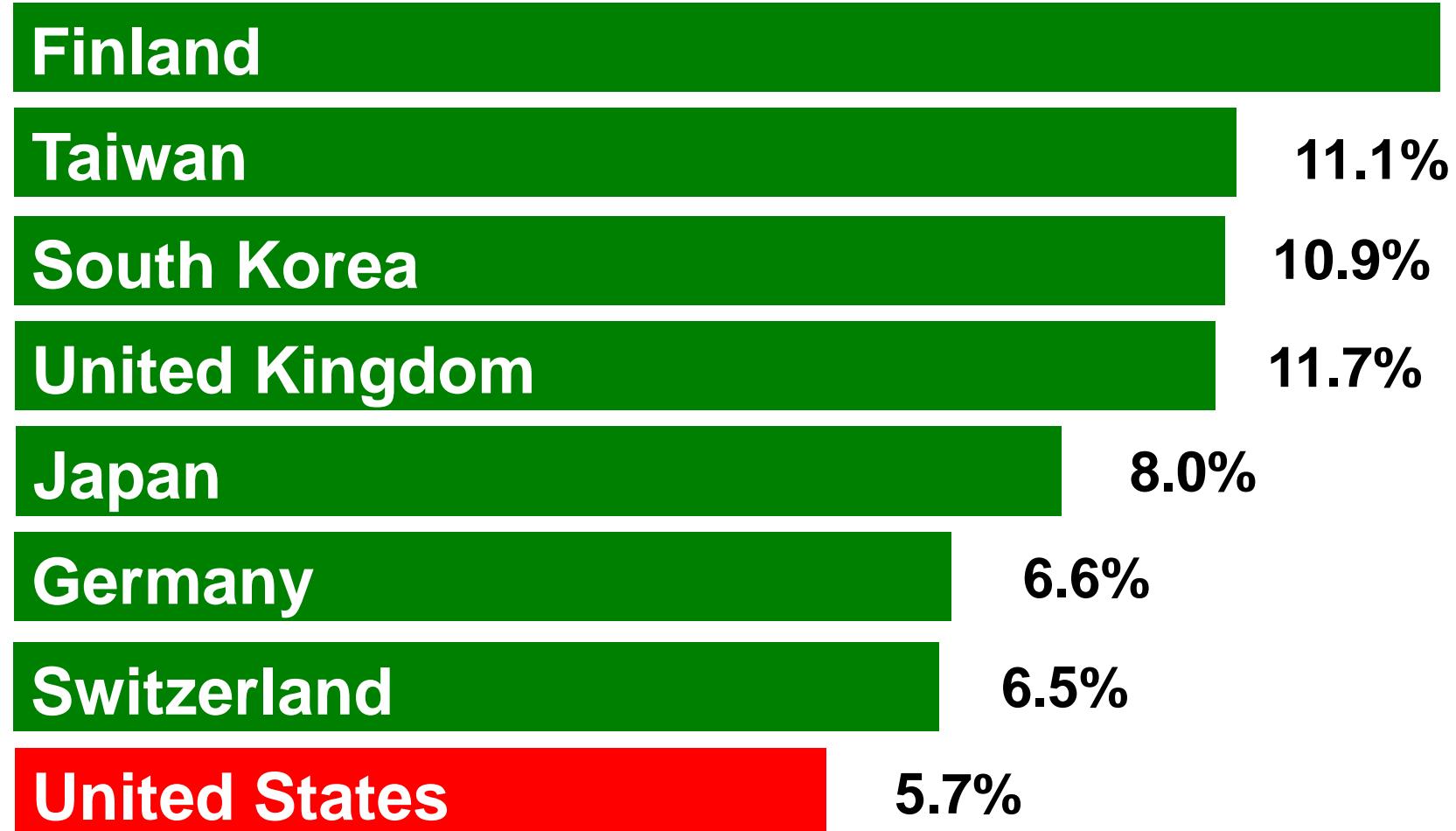


A National Issue

- “An Emerging and Critical Problem of the Science and Engineering Workforce”¹
 - 12 Major studies (1999-2004) make essentially the same point
 - A few studies did not consider security clearance needs and rely on relaxation of immigration rules
- Growing need for U.S. citizens in national security activities

1. National Science Board Companion Paper to “National Science and Engineering Indicators 2004”, National Science Foundation, April 2004

Percentage of 24-year-olds with a Science or Engineering Degree



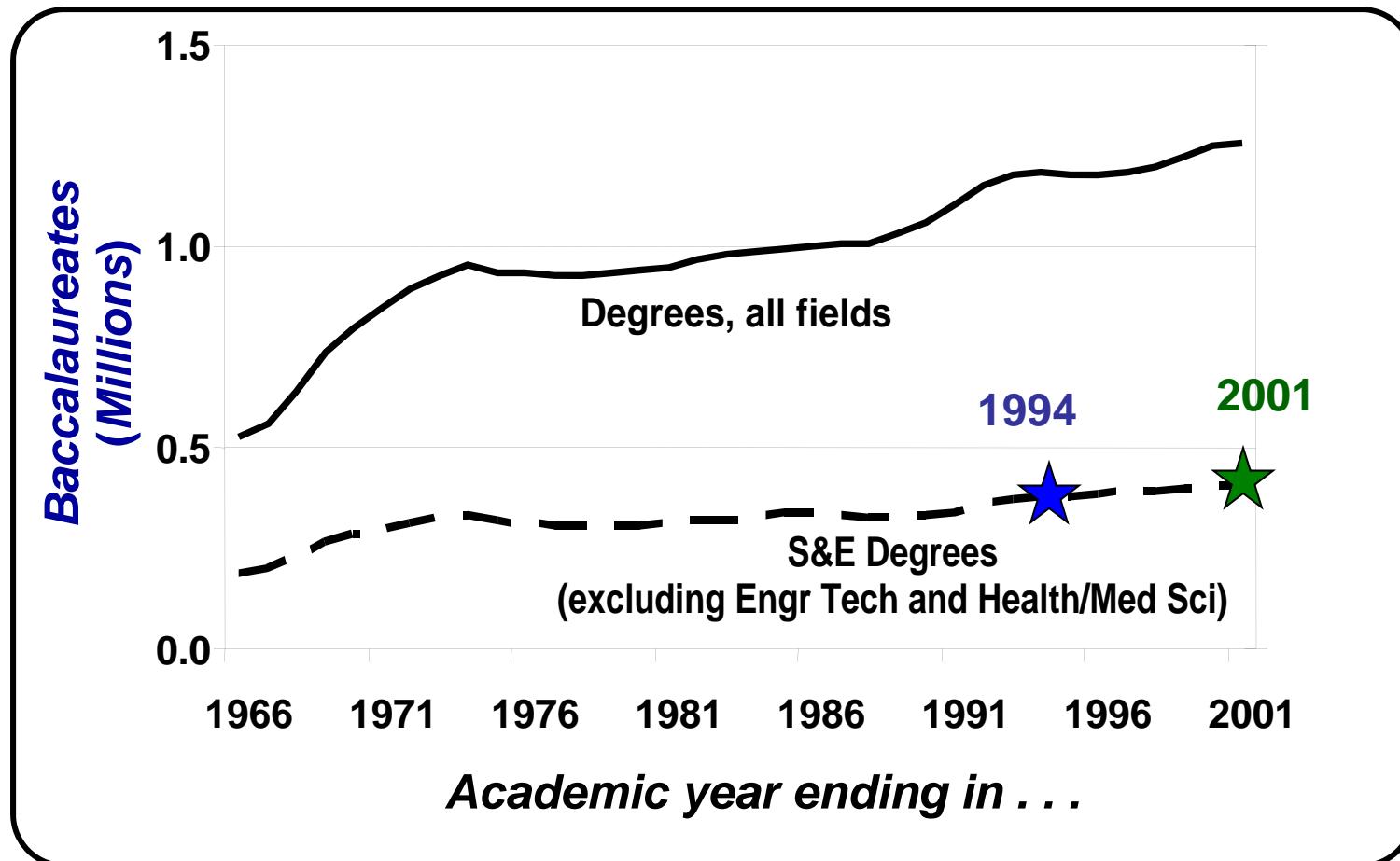
Source: *Money Magazine*, Oct 2004, pg 124

FOUO



U.S. Production of S&E Graduates*

U.S. College and University Graduates, 1966-2001



*Source: Data provided by the NSF, September 2003

U.S. University Trends in Defense-Related S&E Graduate Student Enrollment (1994-2001)



*Source: National Science Foundation – Graduate Students and Post Doctorates in Science and Engineering: Fall 2001

Science Disciplines

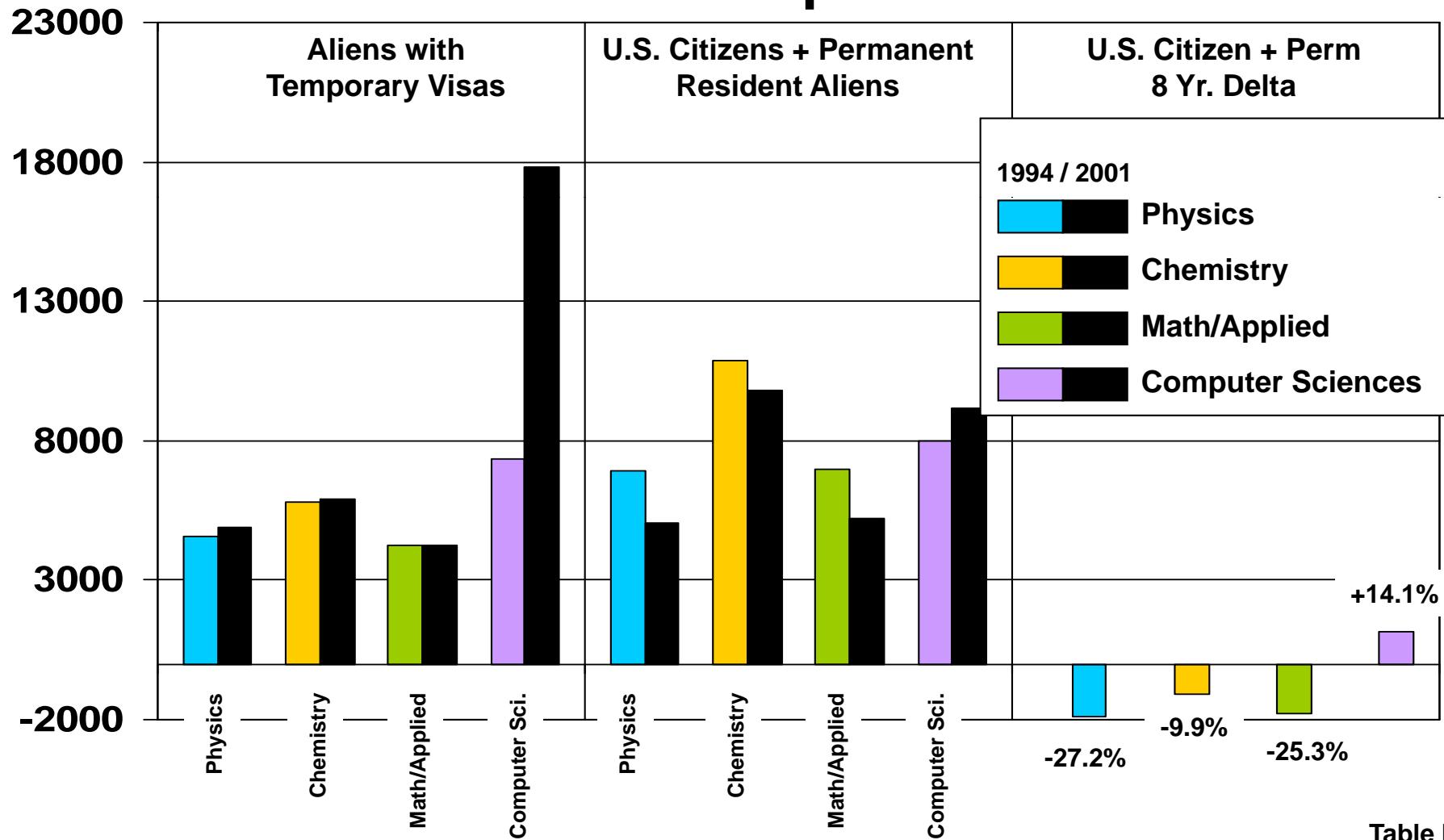


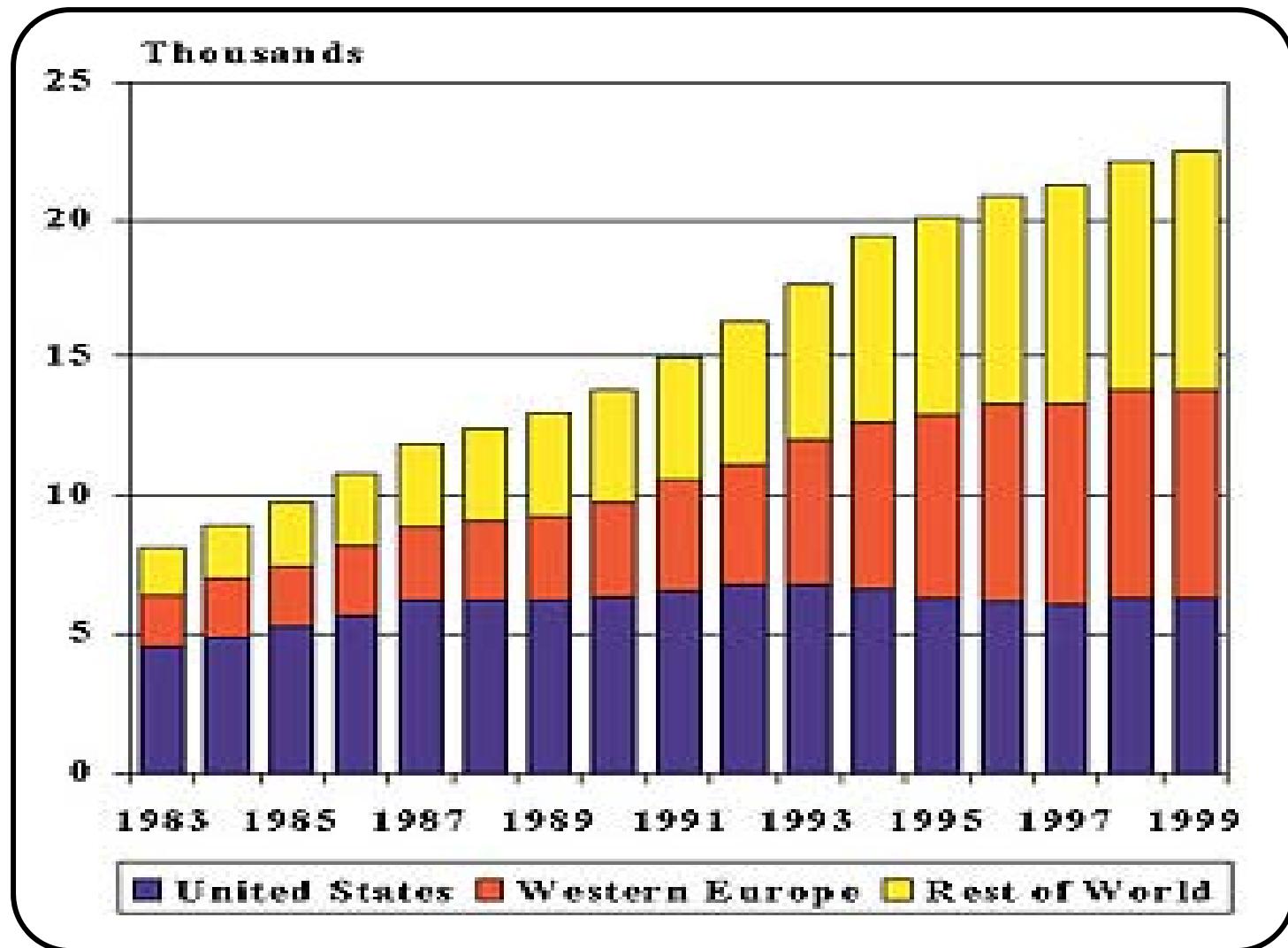
Table I-2



Physical Review Trends

*Physical
Review
&
Physical
Review
Letters*

*Total
Submissions*



Source: American Physical Society - APS News August/September 2000



Security Environment: 4 Challenges

VULNERABILITY

Irregular

- Unconventional methods adopted by non-state and state actors to counter stronger state opponents.
- (e.g., terrorism, insurgency, civil war, and emerging concepts like “unrestricted warfare”)

←
Lower

Traditional

- Military capabilities and military forces in long-established, well-known forms of military competition and conflict.
- (e.g., conventional air, sea, land forces, and nuclear forces of established nuclear powers)

LIKELIHOOD

Higher

Catastrophic

- Surreptitious acquisition, possession, and possible employment of WMD or methods producing WMD-like effects against vulnerable, high-profile targets by terrorists and rogue states. (*paralyze our power*)
- (e.g., homeland missile attack, proliferation from a state to a non-state actor, devastating WMD attack on ally)

→
Higher

Disruptive

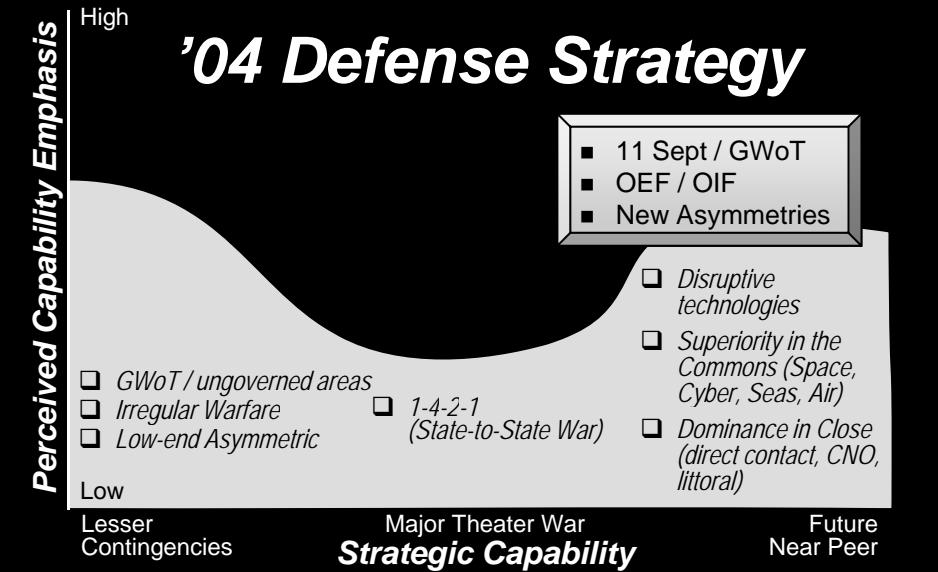
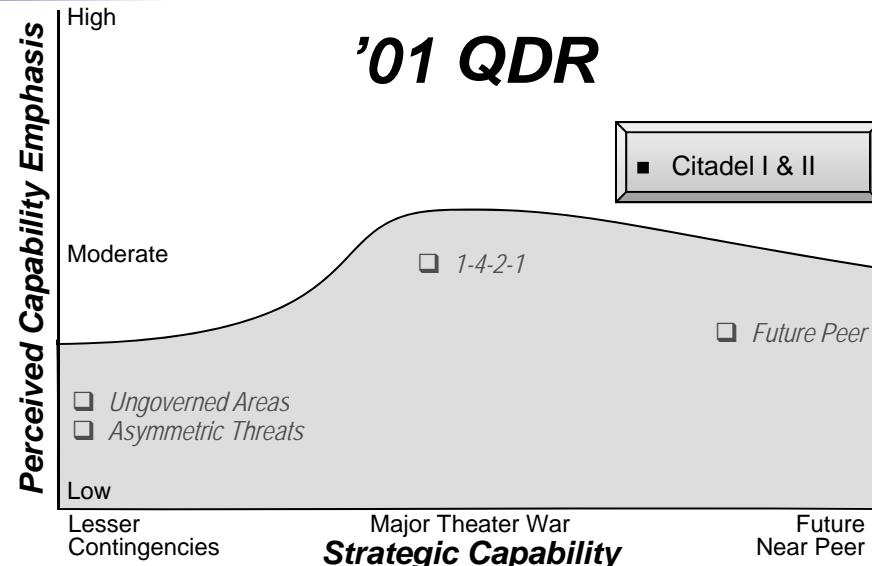
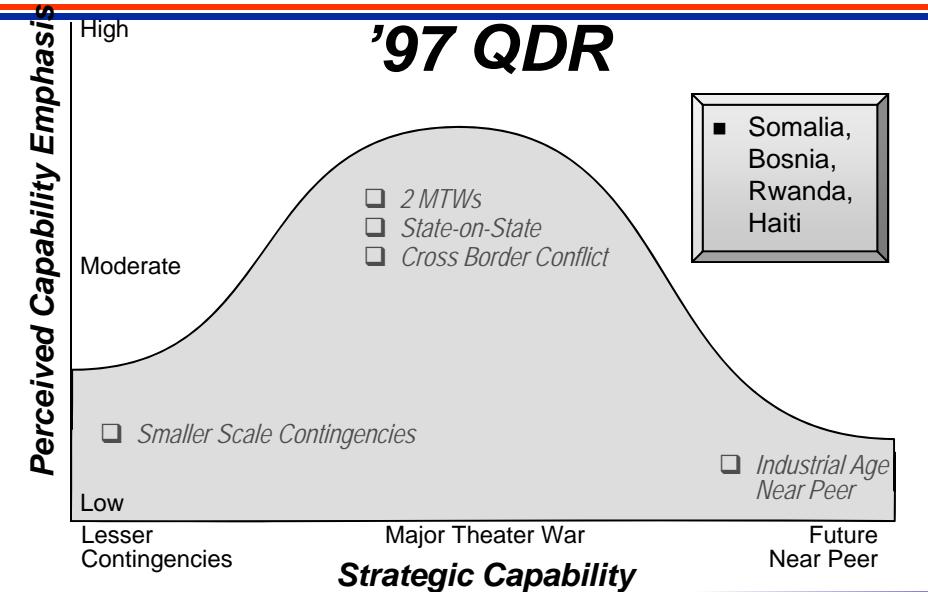
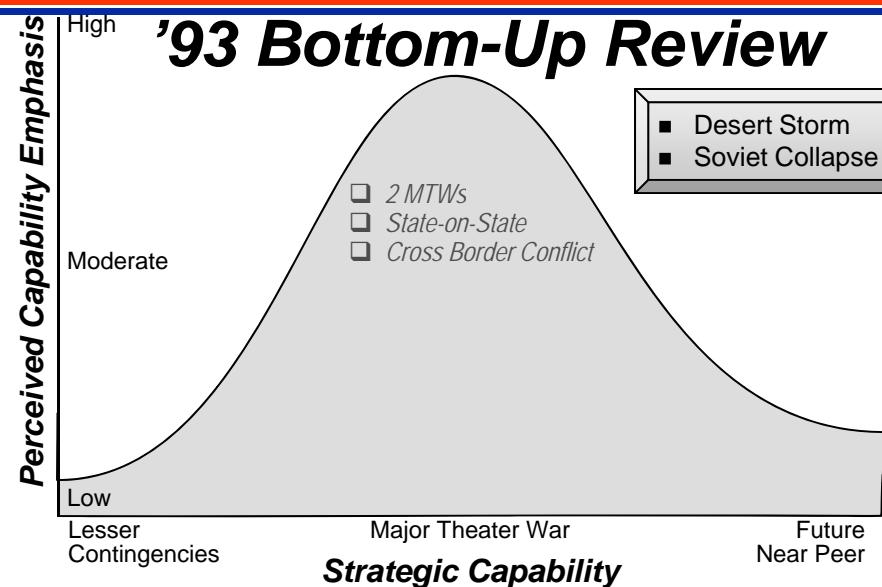
- International competitors developing and possessing breakthrough technological capabilities intended to supplant U.S. advantages in particular operational domains. (*marginalize our power*)
- (e.g., sensors, information, bio or cyber war, ultra miniaturization, space, directed-energy, etc)

Lower

Capabilities-based planning should balance risk across challenges



Decade of Strategic Evolution



Disruptive Technology Dimensions

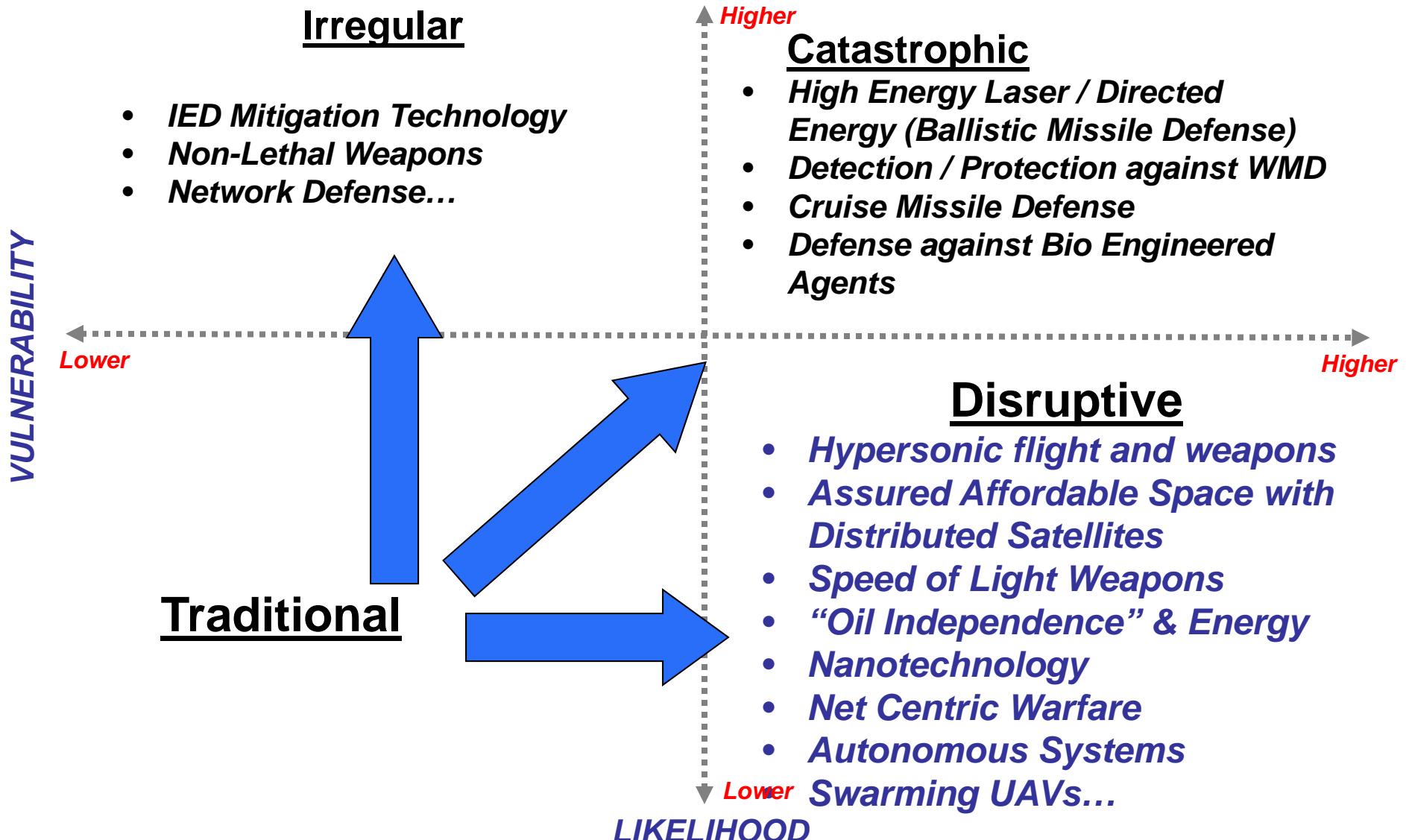
Attributes



- Transformation Occurs With Leaps In Capabilities:
 - Manhattan Project—Lethality
 - Reconnaissance Satellites—Knowledge
 - Stealth—Agility
 - Ballistic Missiles—Speed

Offensive Disruptive Technology is Transformational

Security Environment: Strategy S&T “Thrusts”

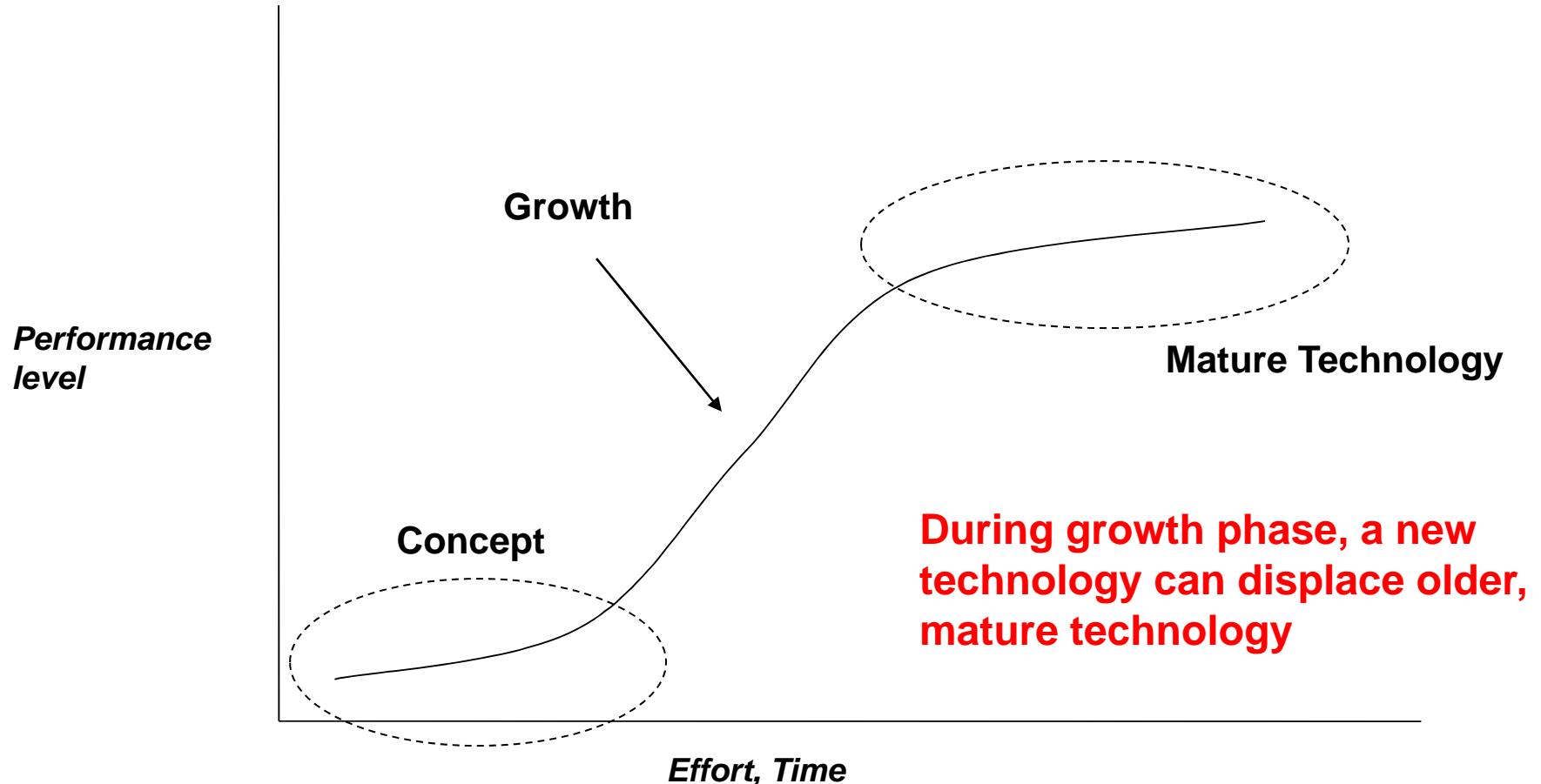




A Final Concept Technology S-Curve

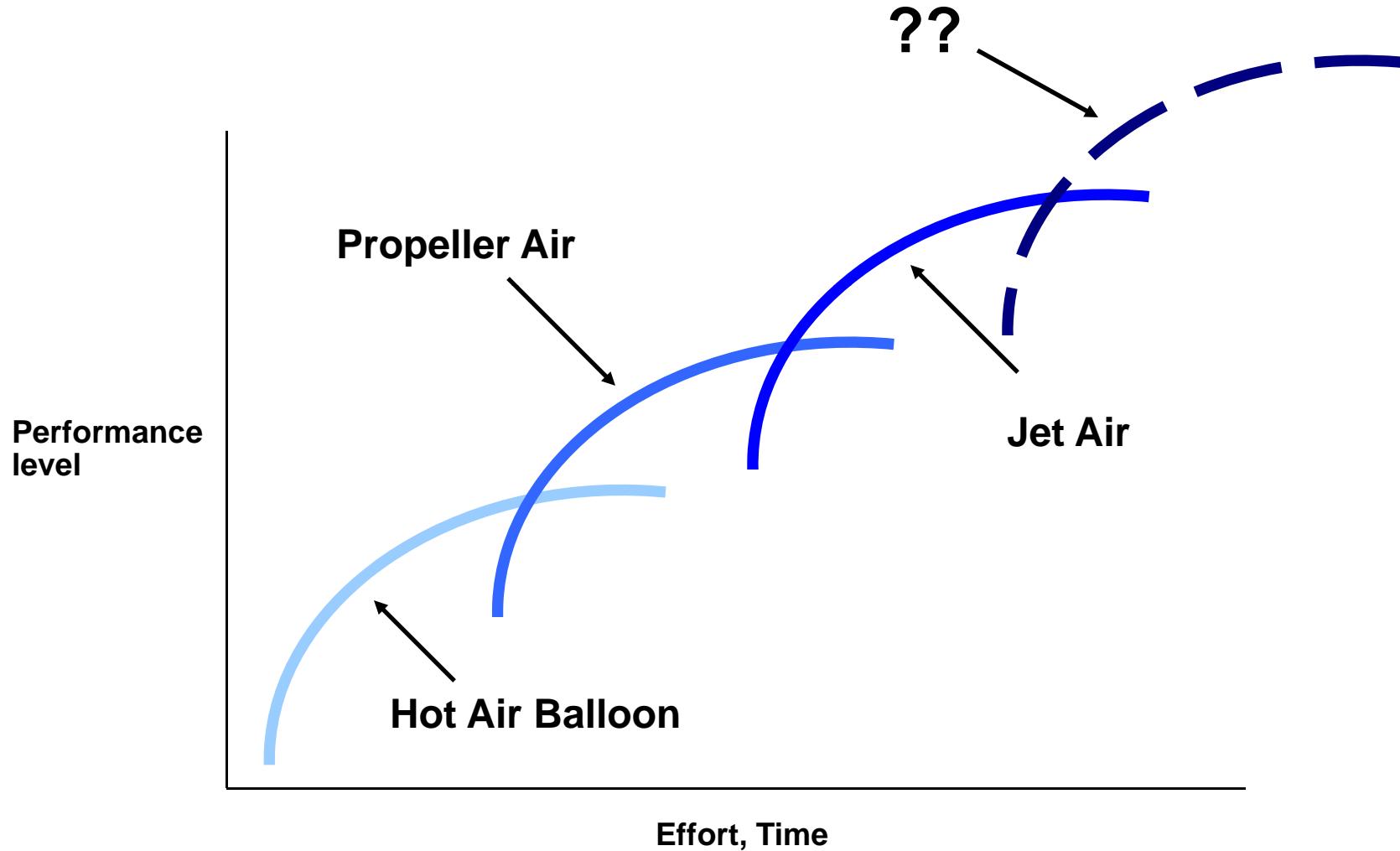
Most Technology maturation follows S-curve:

Initial Discovery, “Product-ization”, then Incremental Improvement



Family of S-Curves

Military Aircraft

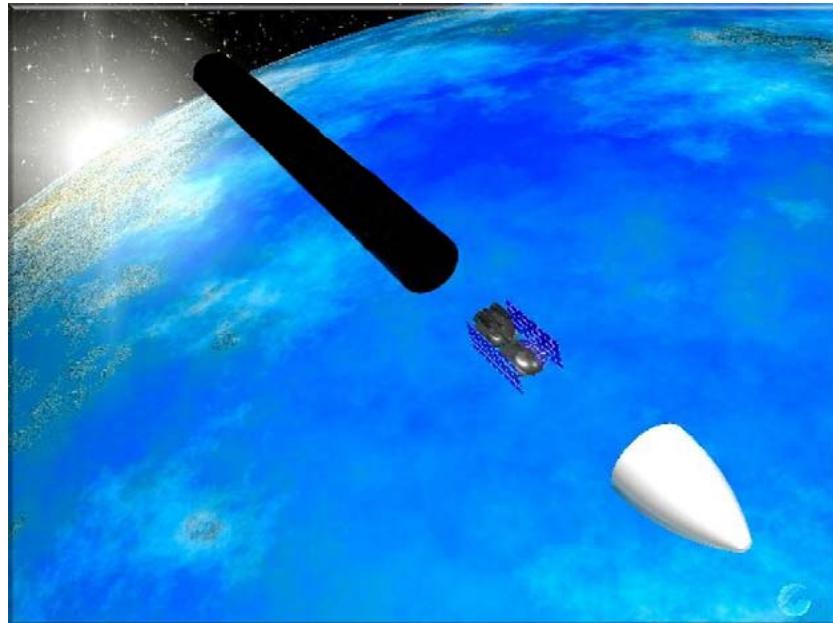


Falcon



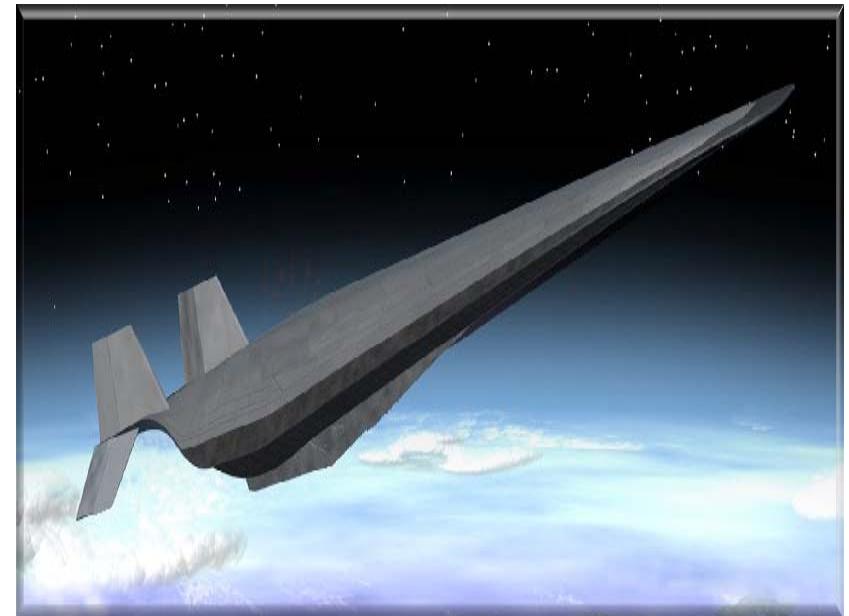
Near-Term Capability

Operationally
Responsive
Spacelift
Capability



Far-Term Capability

Hypersonic Cruise
Vehicle



DARPA – Air Force Program



Propulsion Technology

Turbine Propulsion and Fuels Technology

- Engine Component Development • Demonstrator Engines • Fuels, Lubes, and Combustion



Rocket Propulsion Technology

- Rocket Engine and Fuel Technologies
- Satellite Propulsion • Tactical and Ballistic Missile Propulsion

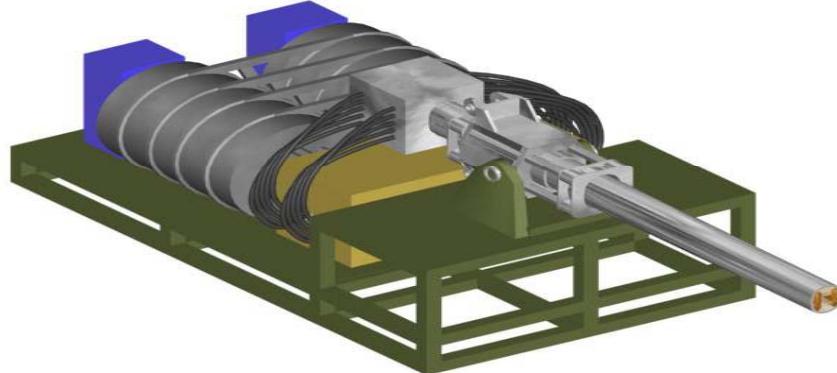
Advanced Propulsion Technology - • Hypersonic Flight (Mach 4-8) Components • Scramjet Demonstrator Engines • Endothermic Fuels



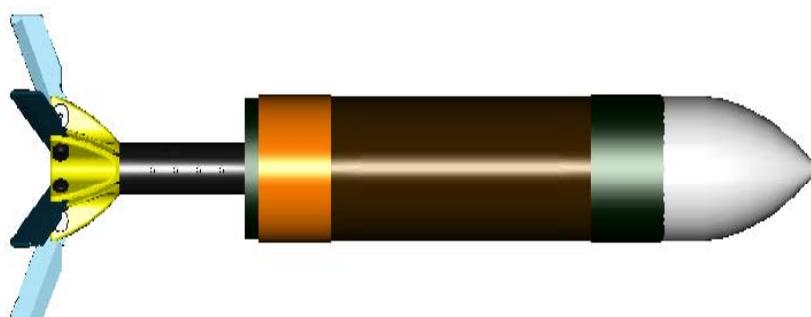
Aircraft and Weapon Power -

- Electrical Power Generation and Thermal Management for Aircraft • High Power Generation and Storage for Space and Directed Energy

Electromagnetic Mortar (EM Mortar)

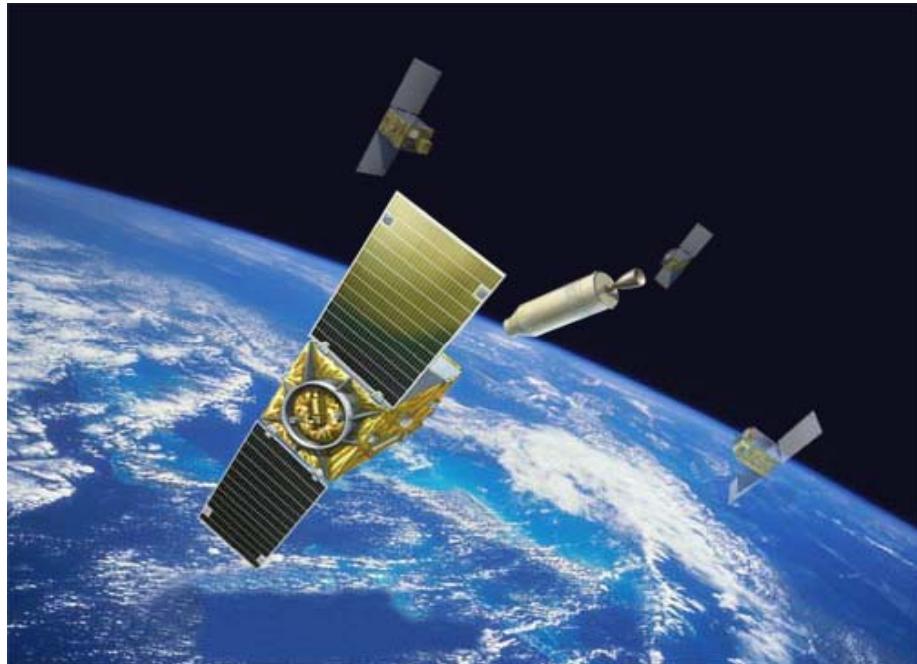


- Precision, lethality, fast response, rapid strike, and versatility for artillery and sensor launch





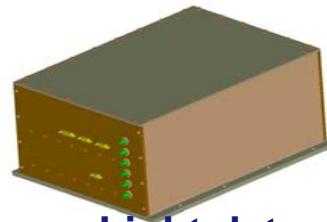
AF XSS-11



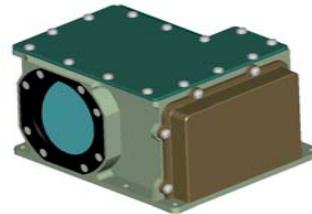
- First demonstration of a fully autonomous satellite designed to demonstrate:
 - Software logic and algorithms to safely rendezvous and navigate around and inspect a resident space object
 - Mission planning, validation, verification tools, and operational tools and techniques
 - Collision avoidance—space situational awareness



3u PCI
Avionics



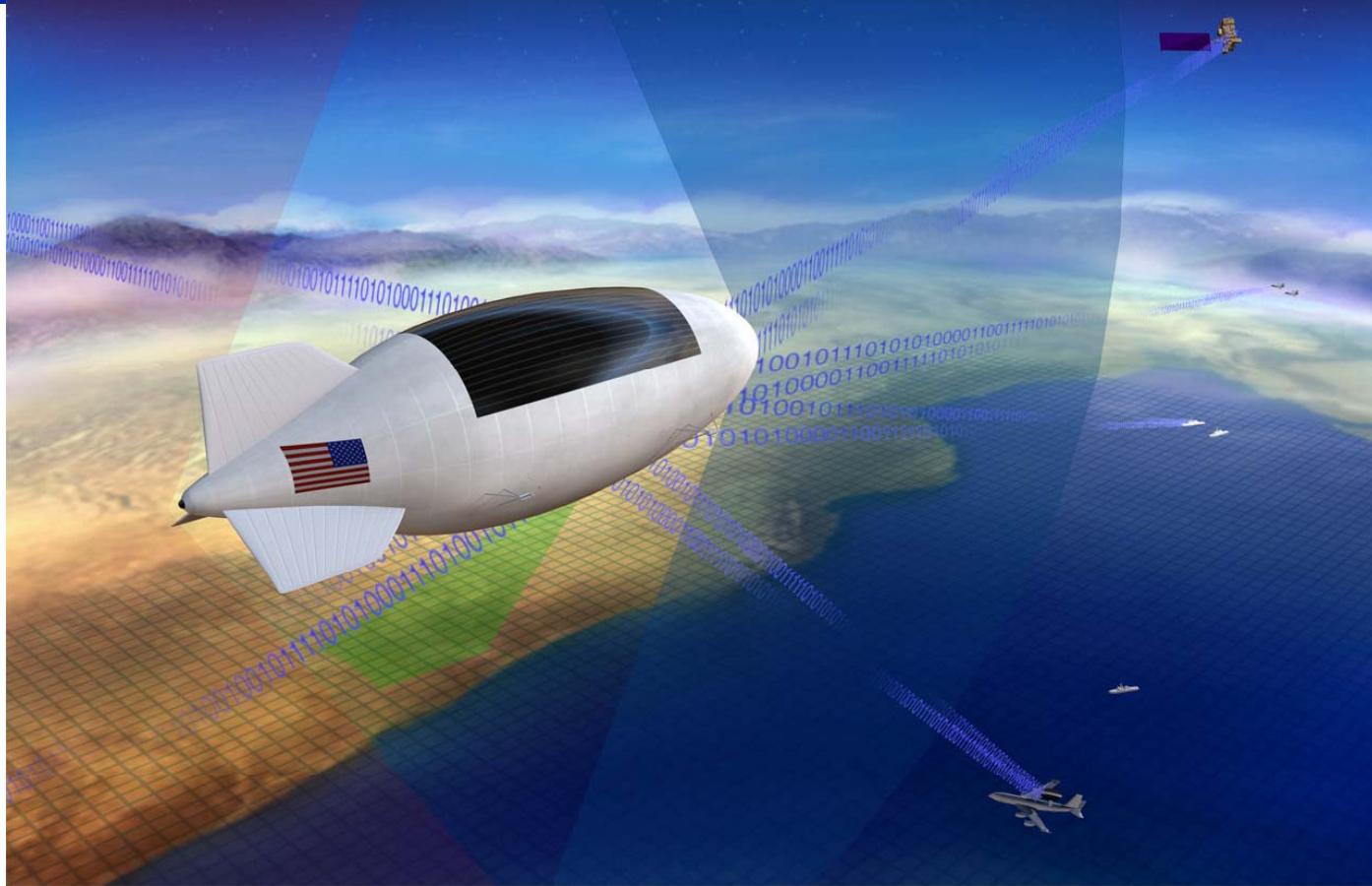
Light detection and ranging
rendezvous system



Integrated imager and
star camera



High Altitude Airship (HAA)



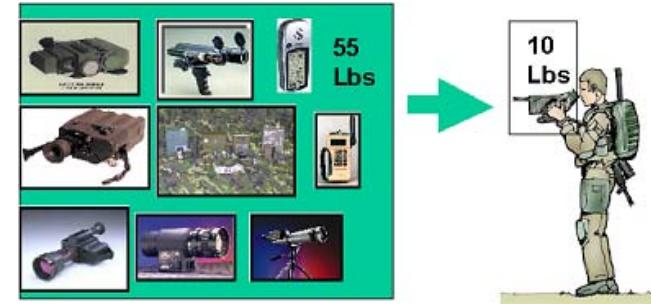
Transformational military capability; potential use as sensor, communications, and/or weapons platforms; demonstrator for future high altitude airships.



Directed Energy

Laser Devices and Analyses:

- Laser Devices - Photon Generators • Solid State and Chemical Lasers • Laser System Effects and Modeling



Laser Beam Control and Optics:

- Atmospheric Compensation/Beam Control Techniques to Get the Beam on Target to Do the Mission • Space Situational Awareness • Laser Communications

High Power Microwaves (HPM):

- Devices for Graduated Effects - Disrupt, Degrade, Damage, Destroy Electronics • Non-Lethal Long-Range Technologies



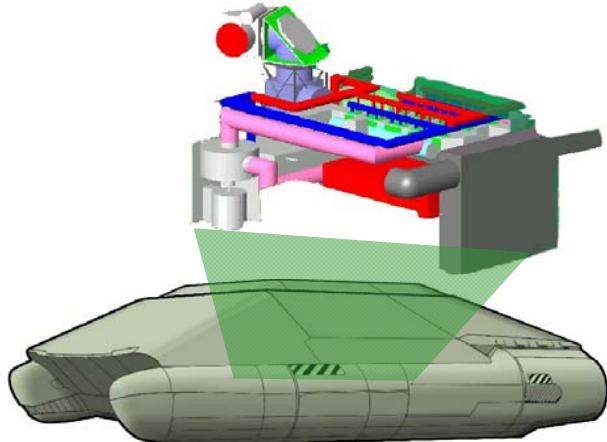
Effects at the Speed of Light

Lethality – Directed Energy



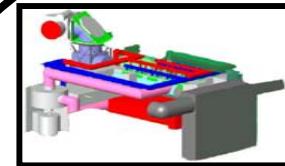
Solid State Laser Weapon

- **SSL Weapon System**
Demonstrator for FCS



High Power Microwave (HPM) Enabling Technology

- **High Power Electronics**
- **Antenna Technology**



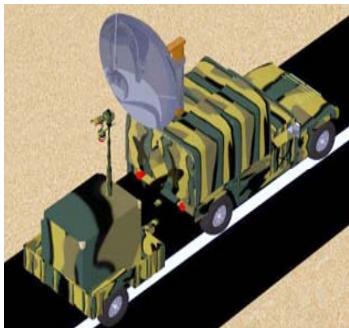
Solid State Laser (SSL)

- **25 kW/100 kW SSL Lab Demo**
- **SSL Weapon System Components**
- **400 kW SSL Lab Demo (FY12)**

HEL/Space Concepts

- **Novel DEW Designs**
- **Space Control Concepts**

Ground-based Mobile Electronic Attack



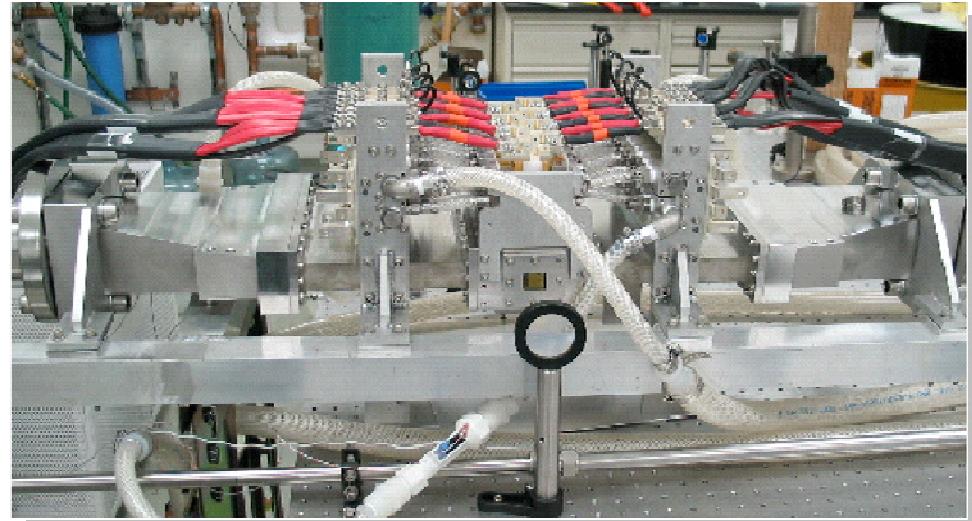
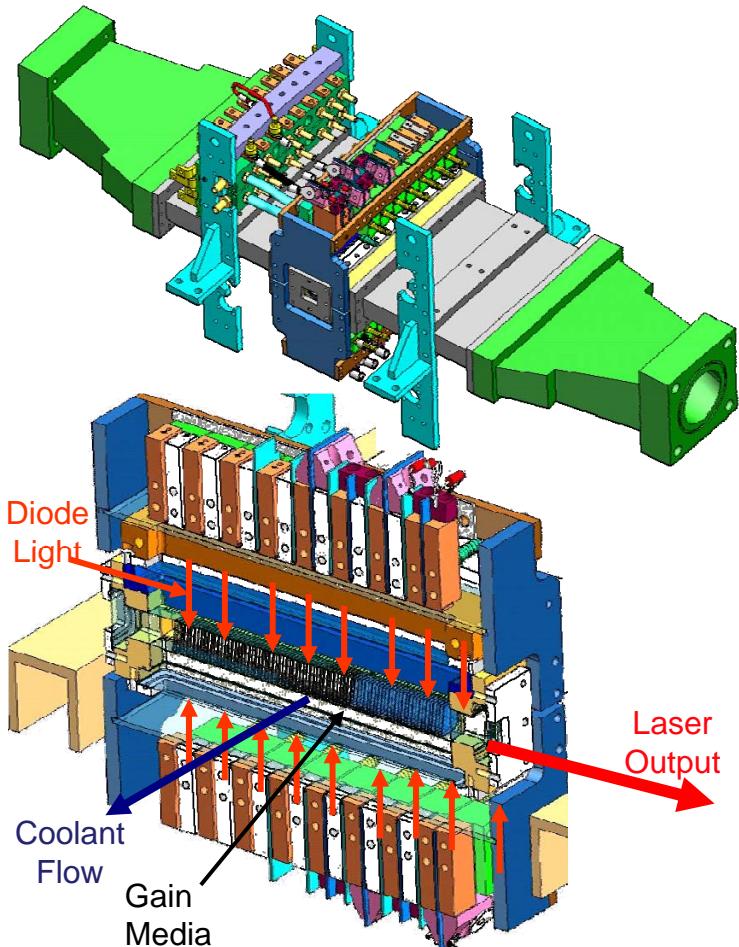
Rheostatic Pulsed Energy Weapon System

Advanced Laser Technology

- **Novel Materials**
- **Beam Combining**
- **New Laser Configurations**



Liquid Laser



- ***Novel Design That Combines the Energy Density of a Solid State Laser with the Improved Thermal Management Qualities of a Liquid Laser***
- ***System Goals: 150 kW Laser Output, 5 kg/kW***
- ***Enables Laser Weapon Systems Integration with Tactical Platforms***



Airborne Active Denial

- Key technologies for airborne non-lethal anti-personnel directed energy weapon
- Non-lethal capability from operational altitudes
 - Deep magazine
 - Speed-of-light
 - Line-of-sight
- Energy beam heats adversary's skin
 - Causes intense pain
 - No damage
 - Forces adversary to flee



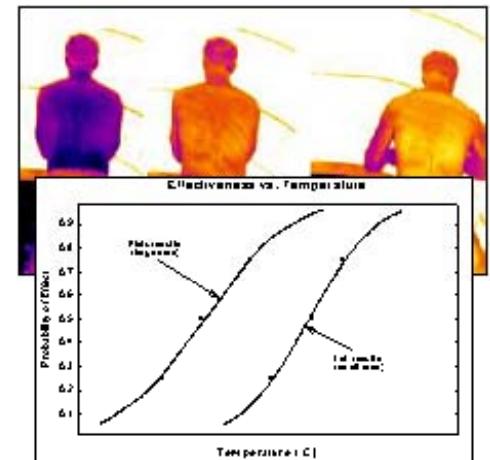
Ground Based ACTD



Advanced Gyrotrons



Electrical Power



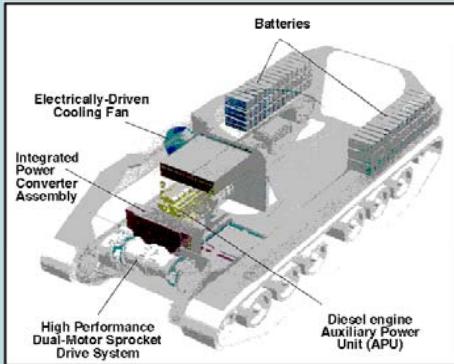
Human Effects Validation

Power and Energy Technologies

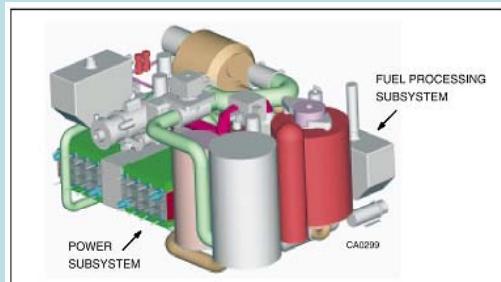
FY06-11



FCS Vehicle Power



Hybrid Electric Drive



Diesel Reformer Power



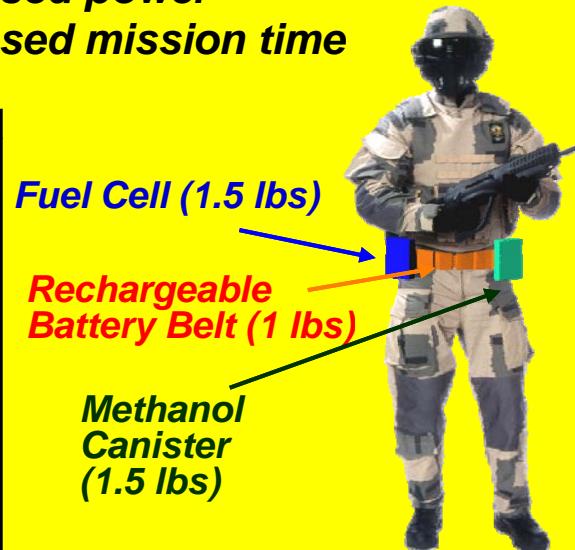
Pulse Power for...
Electric Weapons & Protection
6x Power Density

- All Electric vehicles
- Fuel efficiency
- Silent mobility

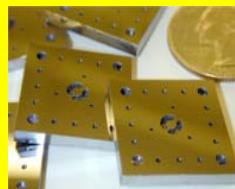
- Minimize deployment time
- Self Sustainment
 - 3 days - High optempo
 - 7 days - Low optempo
- New capabilities
 - Lethality
 - Survivability

Soldier System Power

- Reduce weight
- Increased power
- Increased mission time



**Microturbine/
Microengines**



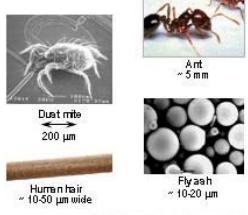
10x Power Density



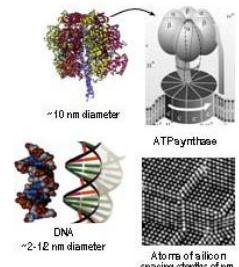
Single-Wall Carbon Nanotubes

The Scale of Things -- Nanometers and More

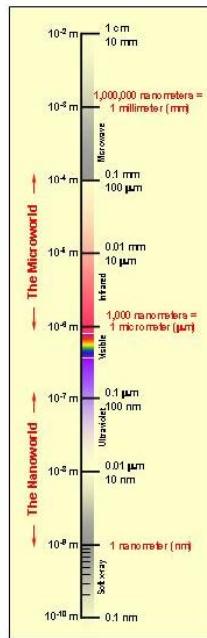
Things Natural



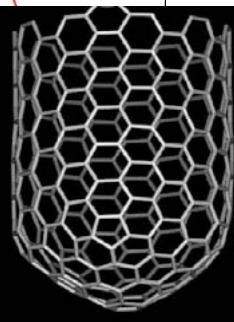
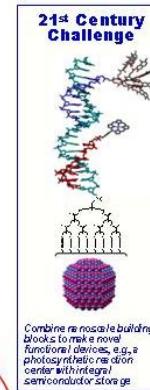
Red blood cells with white cell ~2-5 μm
Human hair ~10-50 μm wide



DNA ~2-12 μm diameter
Atoms of silicon spacing ~tenths of μm



Things Manmade



Objective:

SWNT's are the strongest and the best thermal materials known to man.

Robust program will demonstrate technologies for scaleable production, processing and manufacturing of SWNT's

Payoff:

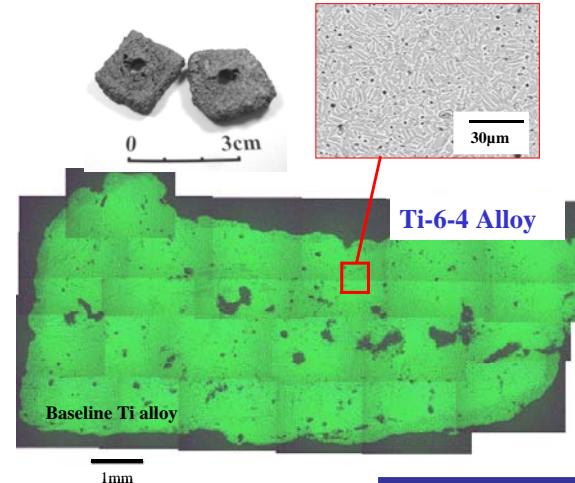
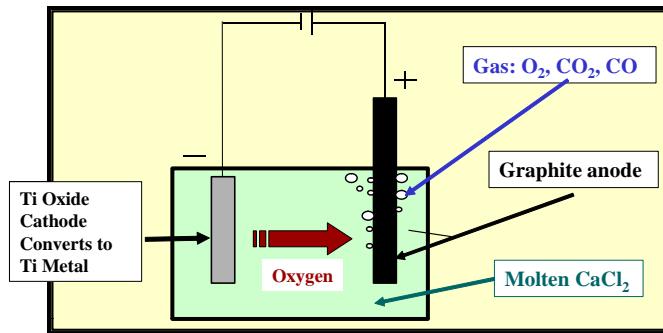
- Light, Strong power/signal harnesses
- Light, high power density motors
- Thermal management/heat pipes
- Regenerable CO₂ scrubbers
- Fuel cells
- Photovoltaics/thermophotovoltaics

Single-Wall Carbon Nanotube (SWNT)

Property	SWNT	Copper	Aluminum
Conductivity	10^4 - 10^7 mho	5×10^5 mho	3.8×10^5 mho
Weight	1.4 g/cc	8.9 g/cc	2.7 g/cc
Stability	inert to 500C	corrodes	surface oxide
Thermal Expansion	-2 ppmC ⁻¹	-16 ppmC ⁻¹	23 ppmC ⁻¹
Thermal Conductivity	20-2000 Wm ⁻¹ K ⁻¹	400 Wm ⁻¹ K ⁻¹	116-235 Wm ⁻¹ K ⁻¹
Tensile Strength	5-20 GPa	0.4-1.5 GPa	0.1-0.6 GPa

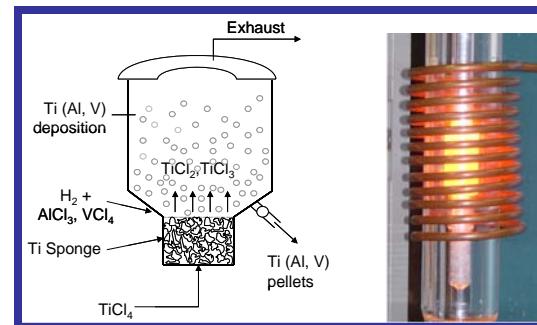


Low Cost Titanium



- Several competitive routes being examined:
 - Electrolytic
 - Fluidized Bed
 - Na Reduction
- Target: < \$4/lb

Cost estimates as low as \$1.00-\$2.50/lb





“SHAPE SHIFT” OVERVIEW

- Undetected Insertion Anywhere on Globe: **Provide Technologies That Enable SOF Platforms, Equipment and Operators to be “Invisible” in All Media (Air, Land, Sea), From All Senses, From All Sensors, in Any Environment**



Outline and Thermal Masking



Full Spectrum Masking

DoD Needs One More “Transformation”



The Information Transformation

Every DoD Researcher, Acquisition Professional, Tester, and Operator should be able to sit down at their Desktop computer and be able to find out:

- What the DoD is doing in R&E
- Why we are doing the work
- When the work will be done
- Who knows more about this information

“Smarter Google” for the RDT&E and Warfighter Community



The Vision





R&E Portal

R&E Portal Home Page - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media Mail

Address https://rdte.sra.com/portal/page?_pageid=34,36601,34_36637&_dad=portal&_schema=PORTAL

R&E PORTAL DoD Research & Engineering

Portal Home R&E News DDR&E Initiatives E-Gov Initiative Financial Management Strategic Plans Congressional Reporting R&E Communities

DDR&E Initiatives

+ National Aerospace Initiative

OBJECTIVES

R&E Portal Help

Help Document

R&E Portal Search

Search

Search Science.gov

Search Advanced Search

Search Firstgov.gov

Search in Federal Only Advanced Search

Search DDR&E Public Website

Search

Search DefenseLink and Other .mil

DefenseLINK
 alltheweb (all .mil)
 Google (all .mil)

DDRE

Go to the DDR&E Website

Defense Technology Search

Submit Query

R&E Applications

Congressional Budget Queries
DDR&E Applications Feedback Form
Defense Science & Technology Planning
Defense Technology Search
In-House S&T Activities Report
Lab Demographics
RDT&E Budget Resource Queries
Virtual Technology Expo

R&E Links

AFIS Early Bird
Air Force Office of Scientific Research
Army Research Office
DefenseLink
DefenseLink List of DoD Sites
Defense Advanced Research Projects Agency
Defense Technical Information Center
Office of Naval Research
OUSD (AT&L)
National Aeronautics and Space Administration
National Science Foundation
Research & Development Descriptive Summaries
Science.gov
S&T Acquisition Workforce

Personal Favorites

S&T Favorites

Portal Favorites

Web Favorites

CNN Edit Go

R&E POC Search

Search:

Start

1:35 PM

DEFENDING THE FUTURE

SPOTLIGHT ON TRANSFORMATION – A booklet titled "Facing the Future: Meeting the Threats and Challenges of the 21st Century," a series of American Forces Press Service articles and a Pentagon Channel TV documentary chronicle the Defense Department's transformation since 2001. [Read the Report](#) [Facing the Future booklet \(PDF\)](#)



Summary

- **Understanding Disruptive Technologies are vital to continued competitive stature**
- **With Increased Knowledge in Rest of World, Pace of Technology, Potential for Technology Surprise Increasing**
- **Need to stay engaged with rest of world to minimize “surprise”**



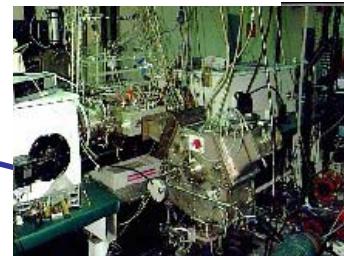
Backup Slides



S&T Can Take Time for Transition



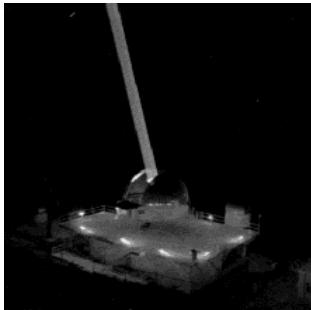
Adaptive Optics



Chemical Oxygen Iodine Laser



Airborne Laser Laboratory



1.5m Telescope



Atmospheric Compensation



3.5m Telescope



Atmospheric Measurements

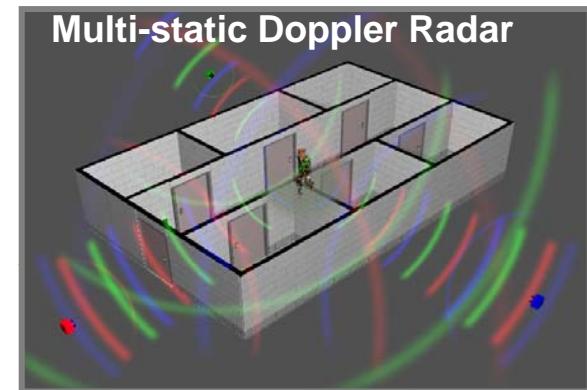
30+ Years of Air Force S&T investments in beam control and high energy lasers have made an ABL Possible



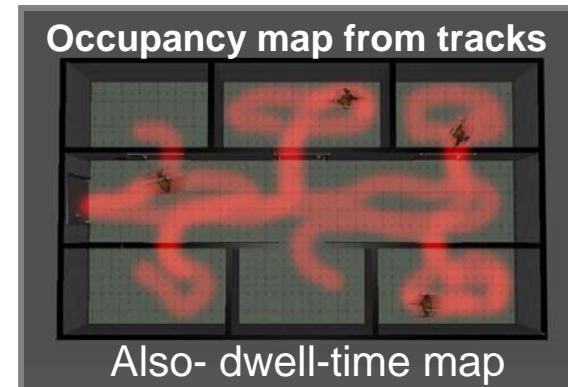
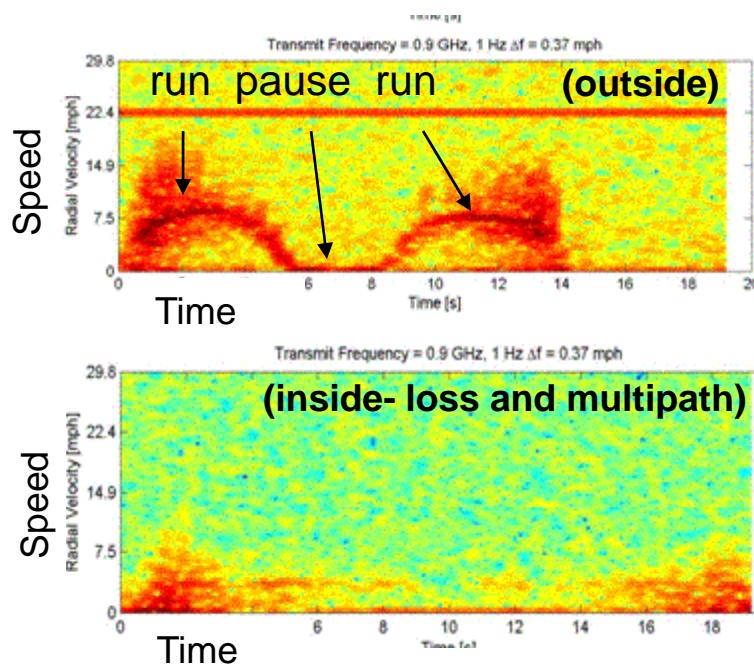
Through-the-Wall Imaging for Urban Operations

- Strategic collection of threat activity patterns and building layout / door properties using exterior sensors
- Tactical detection and localization of adversaries or hostages inside building using exterior sensors

MTI Radar



900 MHz Doppler Returns from walker:



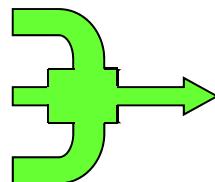


Counter-IED Thrust



- Recently launched (Feb 05) a focused counter-IED research program w/ NRL, University Affiliated Research Centers, etc
- Sustained BASIC Research investment: 10% NRL Base Program; matching ONR extramural funds (to universities, labs, industry, etc.)
- Investment on real-time detection of threat & advanced long-range destruction technologies
- “Feed” USMC CONOPS/Training
- Deliver Counter-IED S&T Roadmap to SECNAV

- Detection at a Distance
- Destruction at a Distance
- Defeat at a Distance



Deterrence

Army S&T Vision— Pursuing Transformational Capabilities



Speed, Reach, and Precision

Current Force



~100 lb. load



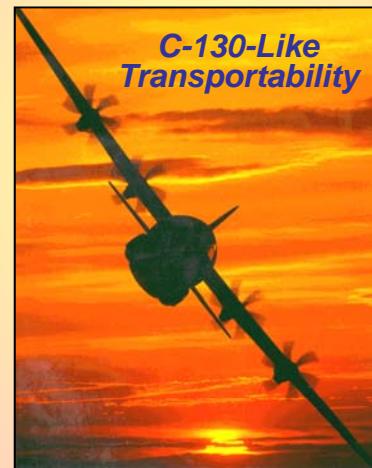
70+ tons



< 10 mph

*From Platforms to
System of Systems*

Enabling the Future Force



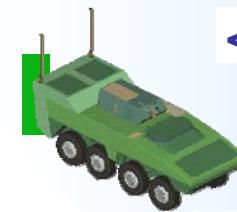
*C-130-Like
Transportability*

Future Force

*< 40 lb.
load*



< 20 tons



> 40 mph

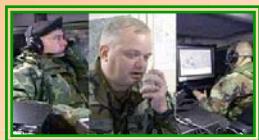
Enhancing the Current Force



Disruptive Technologies



Through Wall Sensing



Network Mining



100kW Lab
Laser Demo



Non-Line of Sight
launch system



Compact Kinetic Energy
Missile (CKEM)

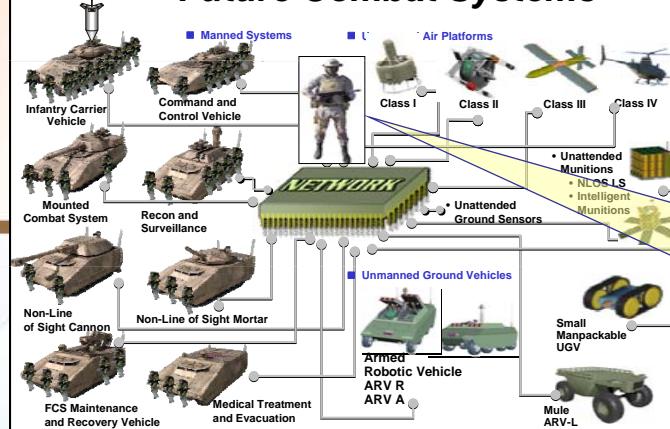


Flexible Displays



Net Centricity

Future Combat Systems



Lethality



FFW



Autonomy



Active Protection



Survivability



Full Spectrum
Command



Flatworld



Training



Virtual Dilemma



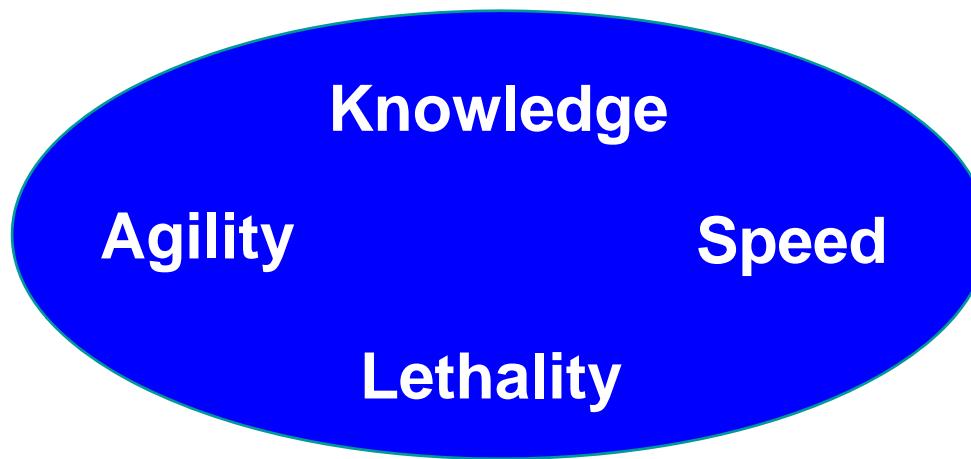
Swarming

Robotics

**Providing Strategically Responsive Forces with Information Dominance
and Paradigm Shifting Lethality & Survivability**

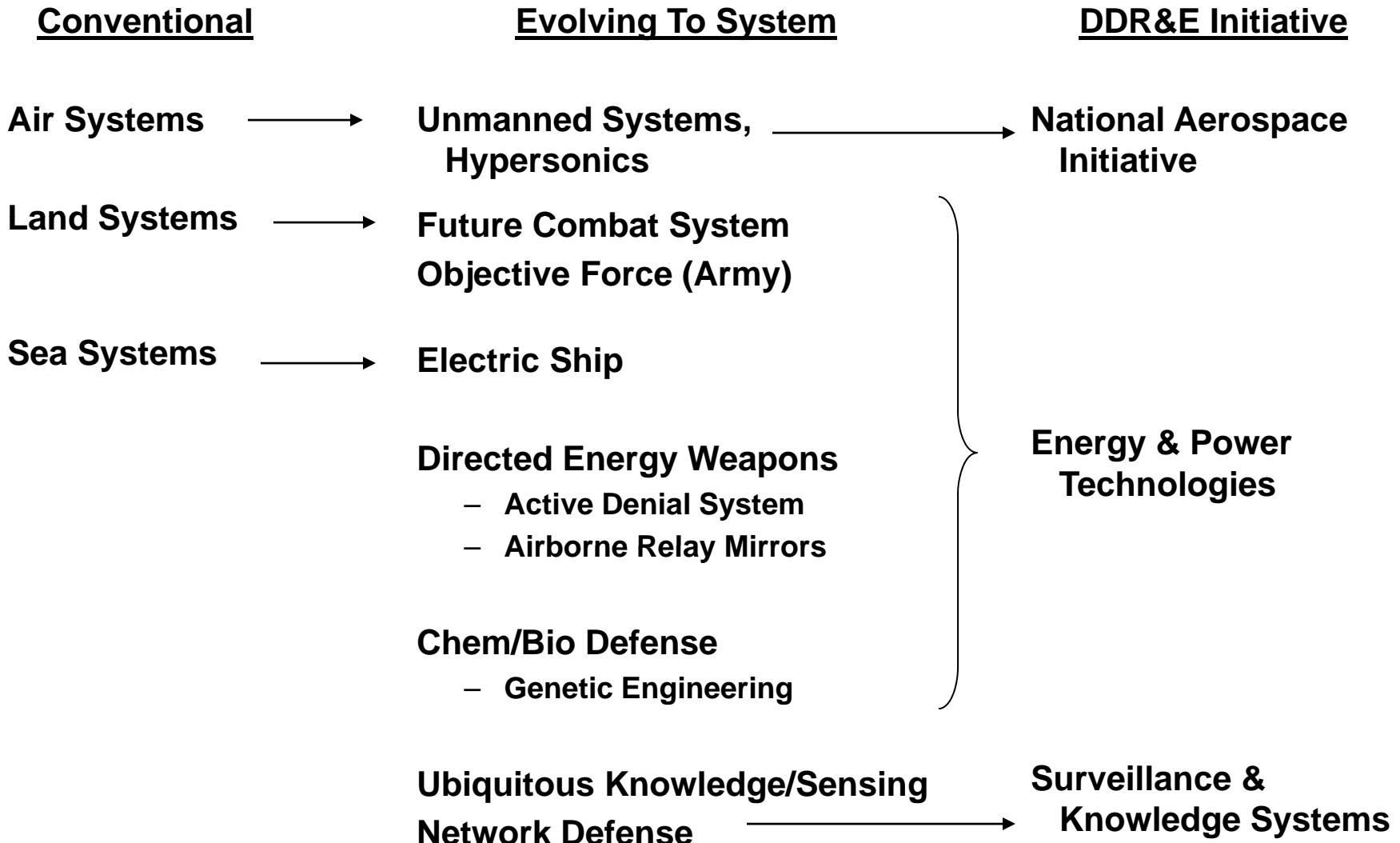
Technology and Transformation

Transformational Attributes



- **DDR&E Transformation Technology Initiatives**
 - **National Aerospace Initiative**
 - **Surveillance and Knowledge Systems**
 - **Energy and Power Technologies**

Traditional Systems Tend to be Mature



Lethality - Missiles



Non Line-of-Sight



Launch System

- **Extended Range**
- -- PAM >50 km/LAM >100 km
- **Increased Loiter / LAM-60 min**
- **Increased Engagement Capability**

NLOS-LS Air & Ground Variants

- Additional Missile Variants
- Networked Missiles
- Improved Affordability

CKEM

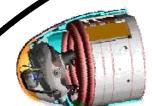
- **FCS Spiral**
- **Lethality Overmatch**
- **5 ft / 100 lbs**
- **On-the-Move Capability**



Guidance & Control

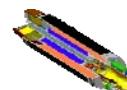


Seeker Technology



- Multimode
- Miniaturization
- Automatic Target Acq

Propulsion Technology



- Increased Velocity
- Longer Range
- Energy Management

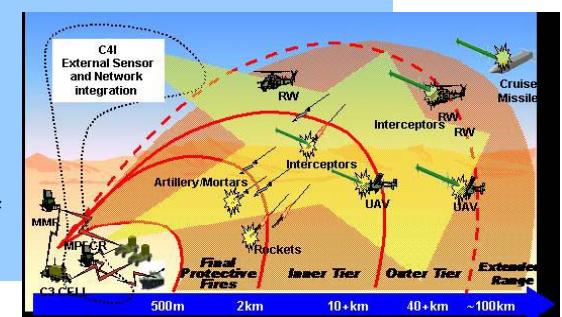
Hypersonic Engine

Smaller, Lighter, Cheaper (SLC) Missiles



- Accurate/Maneuverable Urban Weapons
- Lighter/Cheaper Manportable Weapons
- Vehicle, Building & Personnel Targets

Defense Against Rockets, Artillery & Mortars & UAV/CM

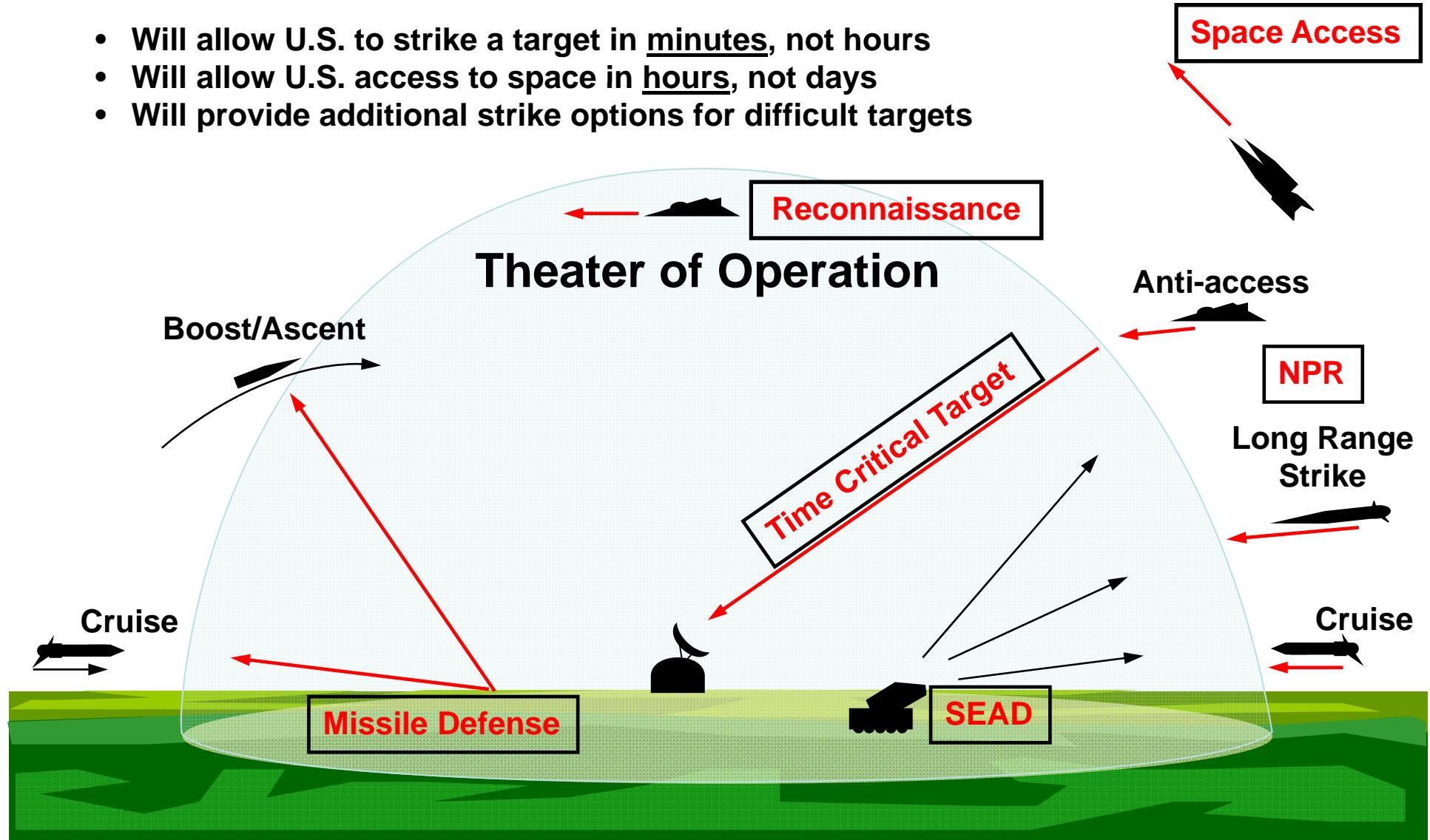


Precision Missiles for FCS/Future Force



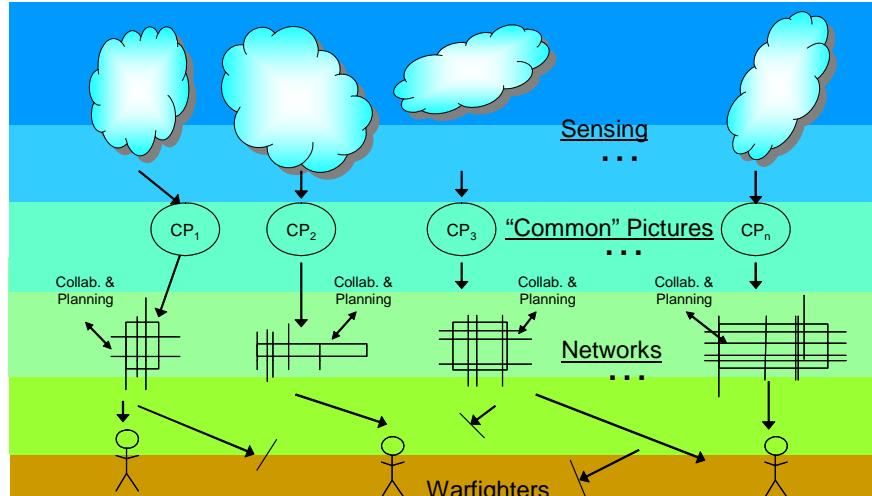
Value of Speed

- Will allow U.S. to strike a target in minutes, not hours
- Will allow U.S. access to space in hours, not days
- Will provide additional strike options for difficult targets

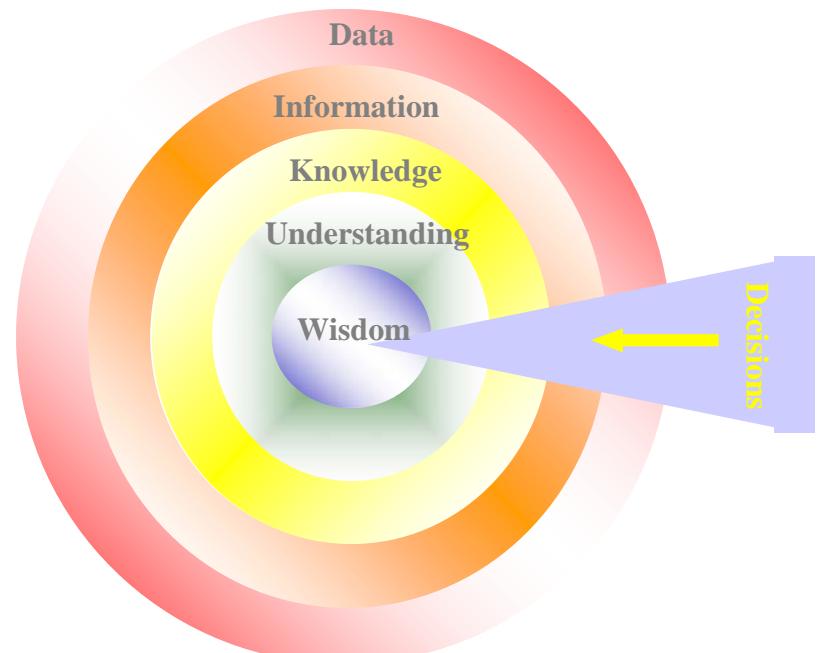
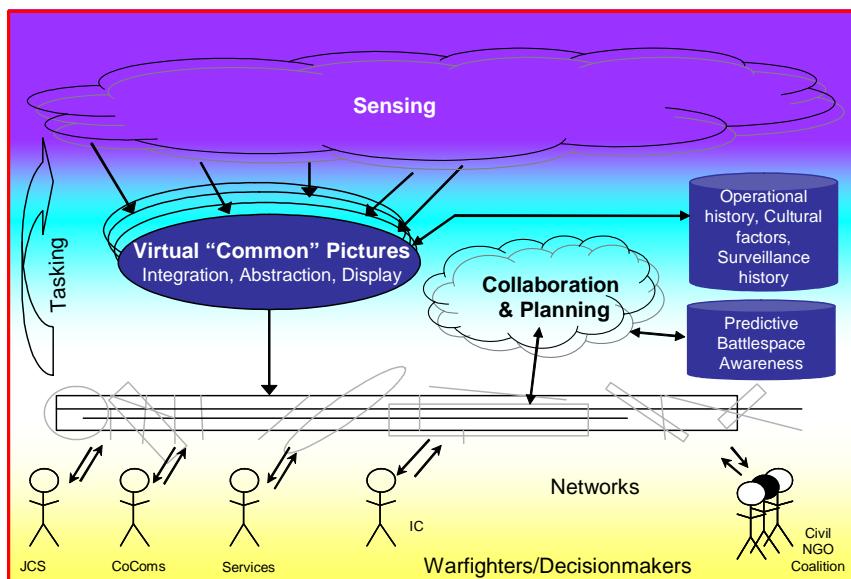


Surveillance and Knowledge Systems

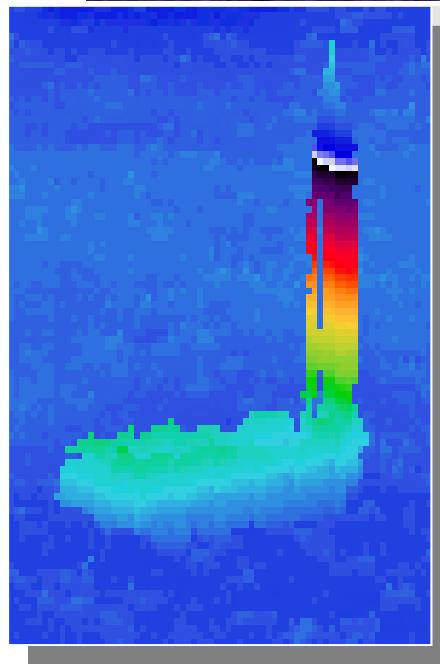
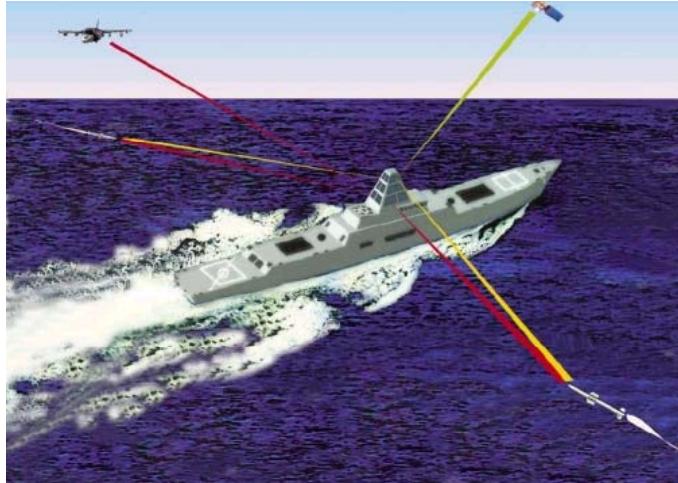
Enabling Integrated C4ISR



- Adaptive Networks
- Ubiquitous Sensors
- Decision Aids



Sensors Are Becoming Part of the System



Some Exciting Initiatives

- Interactive remote sensing: Assisted sensing, laser imaging, 3-D sensors
- Sensor webs & fusion: Smart Sensorweb, proliferable microsensors
- Advanced Multifunction RF System (AMRFS): EW, RF, Radar, Comms
- Microsatellites: Multi-function/mission, cooperative sensor arrays in space.

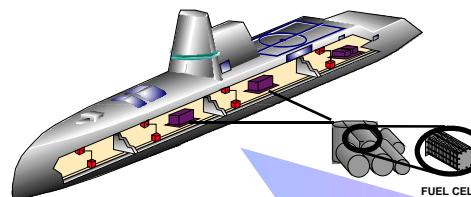


Power Technologies

Pervasive & Enabling



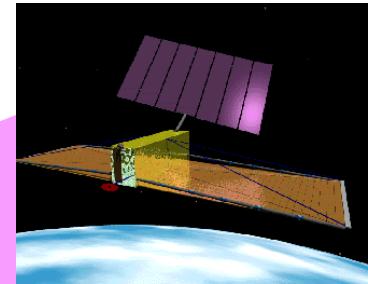
POWER GENERATION
<ul style="list-style-type: none">• Fuel Cells & Fuel Reforming• Novel Power
ENERGY STORAGE
<ul style="list-style-type: none">• Batteries• Capacitors
POWER CONTROL AND DISTRIBUTION
<ul style="list-style-type: none">• Switching & Conditioning• Power Transmission & Distribution• Thermal Management



Electric Warship



More Electric Aircraft



Space Based Radar



High Power Microwave

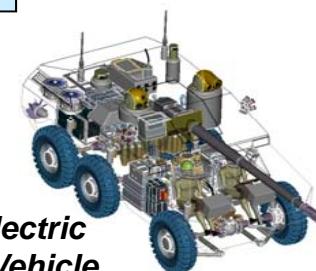
FY02

FY12

New Operational Capabilities



Electric/Hybrid Weapons



Hybrid/Electric Combat Vehicle

Power Needs



HIGH ENERGY LASERS

Electric High Energy Laser Pulses Can:

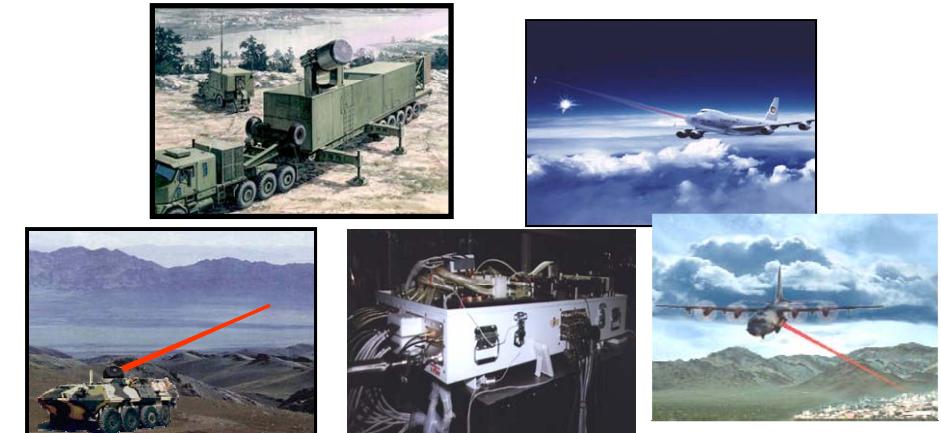
- Cause thermo-mechanical damage
- Provide graduated lethality
- Offer low cost per kill

Applications/Missions:

- Illumination and range finding
- Ground and aircraft-based weapon
- Air and missile defense
- Ship self-defense

Required Technologies:

- 2X more power efficient diode packages
- 100X increased diode package reliability
- 10X higher individual slab/rod/fiber power levels
- Beam combining techniques
- Improved thermal management (10X lower weight)
- Weight efficient power conditioning (pulsed & CW) [10X lower weight]



Warfighter Payoff

- Greatly reduced logistic needs (gal's of JP-4 vs \$1M missile)
- Increased Lethality against:
 - Boosting TBMs
 - Maneuvering Threats
 - Swarm Threats
 - Threats in close proximity to noncombatants

High Power Microwave (HPM) Weapons



High Power Radio Frequency/Microwave Pulses that can:

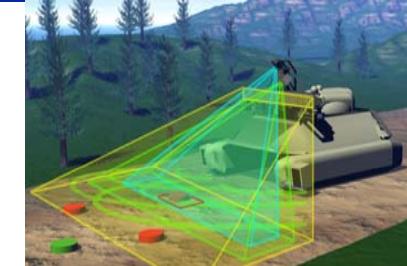
- Upset and/or Damage Electronics
- Produce Non-Lethal Effects on Personnel
- Floods Target Area - High P_{hit}
- Rheostatic Target Effect (Temporary to Permanent)

Applications/Missions:

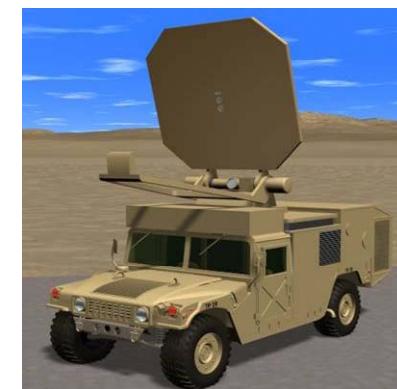
- Counter Command and Control/Infrastructure, etc.
- Vehicle/Platform Protection (Counter Mines/ Munitions)
- Anti-Personnel/Area Denial/Crowd Control
- Air/Missile Defense

Required Technologies:

- 75% Smaller High Power/Gain Antennas
- Effects/Sources Modeling and Simulation
- Pulse Power for Mobile Platforms
- 2X Operating Voltage for Pulsed Switches
- 4X Energy Density for Capacitors
- 2X Operative Voltage for Power Distribution Cables



Counter mines/munitions



Counter personnel (non-lethal-to-lethal)

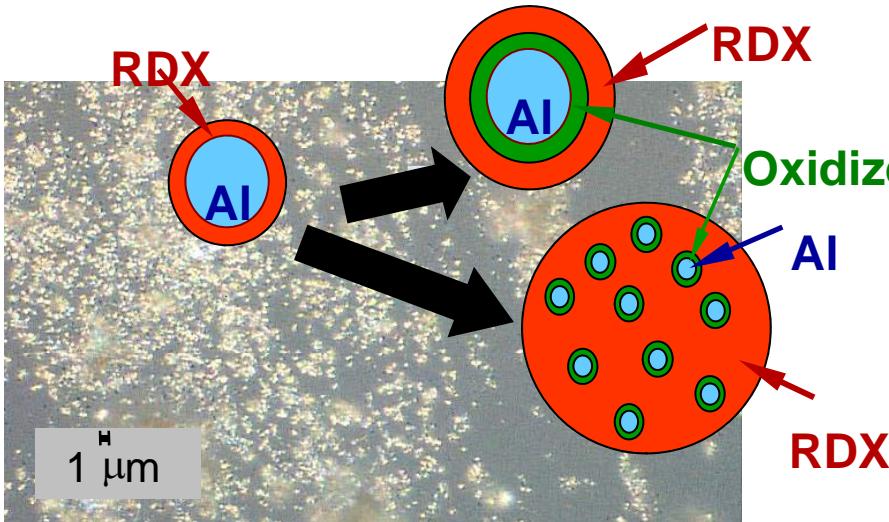
Warfighter Payoff

- 40% system weight reduction
- 90% system volume reduction
- Low collateral damage
- Greatly reduced logistics

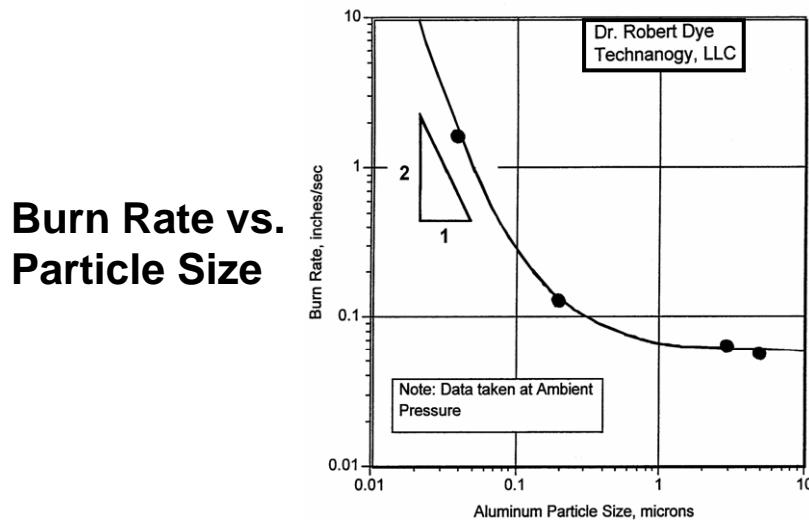


Nano Energetics Example

Potential Payoff in Revolutionary Explosives



Nanoscale Aluminum, Coated by RDX



Nano fuel particles coated by oxidizer

- 100x power – increase in energy release rate
- 2x total energy – greater surface and internal volume free energy available
- 10x efficiency – near 100% complete reactions
- 10x safer – lower sensitivity to mechanical initiation
- More compact - no binder

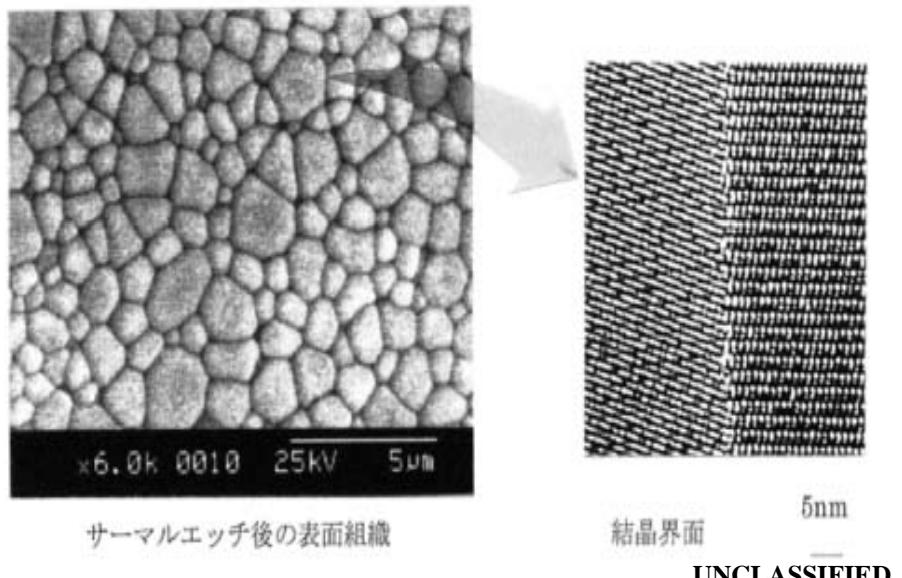
Payoff to the Warfighter

- Smaller, safer munitions
- More kills per event
- Decreased logistics tail
- Enables small, weaponized UAVs



Foreign Example

Nanocrystalline / Nanostructured materials



Developed by Konoshima Chemical Co

PLM - higher strength & toughness;
Larger sizes; Currently 20% less expensive

Technology can be applied to :

- Transparent armor
- Electromagnetic windows
- IR dome materials
- Sensor windows
- X-ray scintillator materials

- Japanese novel patented process to produce YAG nanoparticles

- Liquid-phase chemical reaction
- No pressure required, low temp.
- 100 nm average diameter
- Largely homogeneous



The Future

- **Office of the Director, Defense Research and Engineering asked to study Disruptive Technologies**
 - Will impact Quadrennial Defense Review formulation
 - Probable FY06 start-up initiative
- **Disruptive Technologies are uncertain**
 - Final use may not be predictable
 - Need to “seed” lots of efforts
- **Seeking help looking to the future**



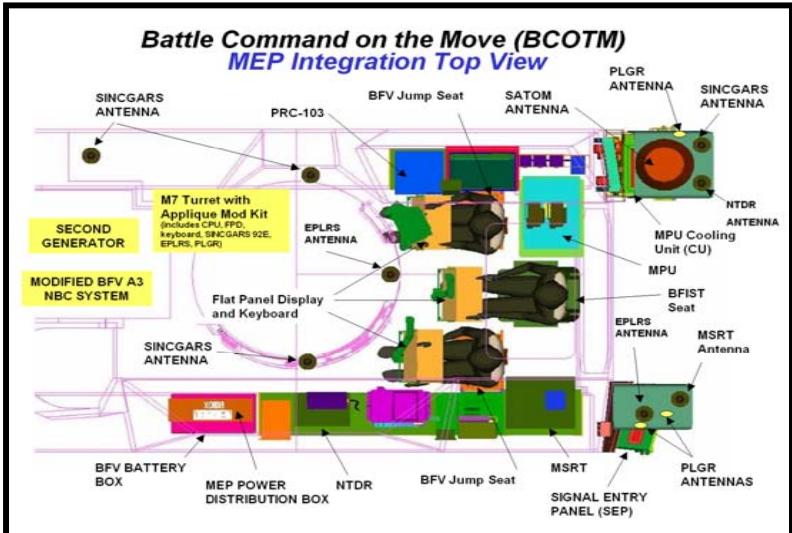
Disruptive Technology Example: National Aerospace Initiative



Disruptive Technology Example: Surveillance & Knowledge Systems



Example of Impact in OIF



Battle Command on the Move (BCOTM) In support of PM-Platforms and PM-

Bradley, CERDEC designed and developed the Mission Equipment Package (MEP) installation for the BCOTM platform for the 4th ID. The installation integrated the BFA Computer Systems (AFATDS, AMDWS, FBCB2, MCS, ASAS) into a C2 system that provides near real-time battlefield information focused on intelligence, effects and maneuver. Five M7 Bradley vehicles were modified and delivered to the 4th ID within 40 days of project initiation. They are currently deployed for use in OIF, providing the battlefield commander the unique capability of maintaining situational awareness and effectively executing battle command tasks while on-the-move and not tethered to his Command Post.

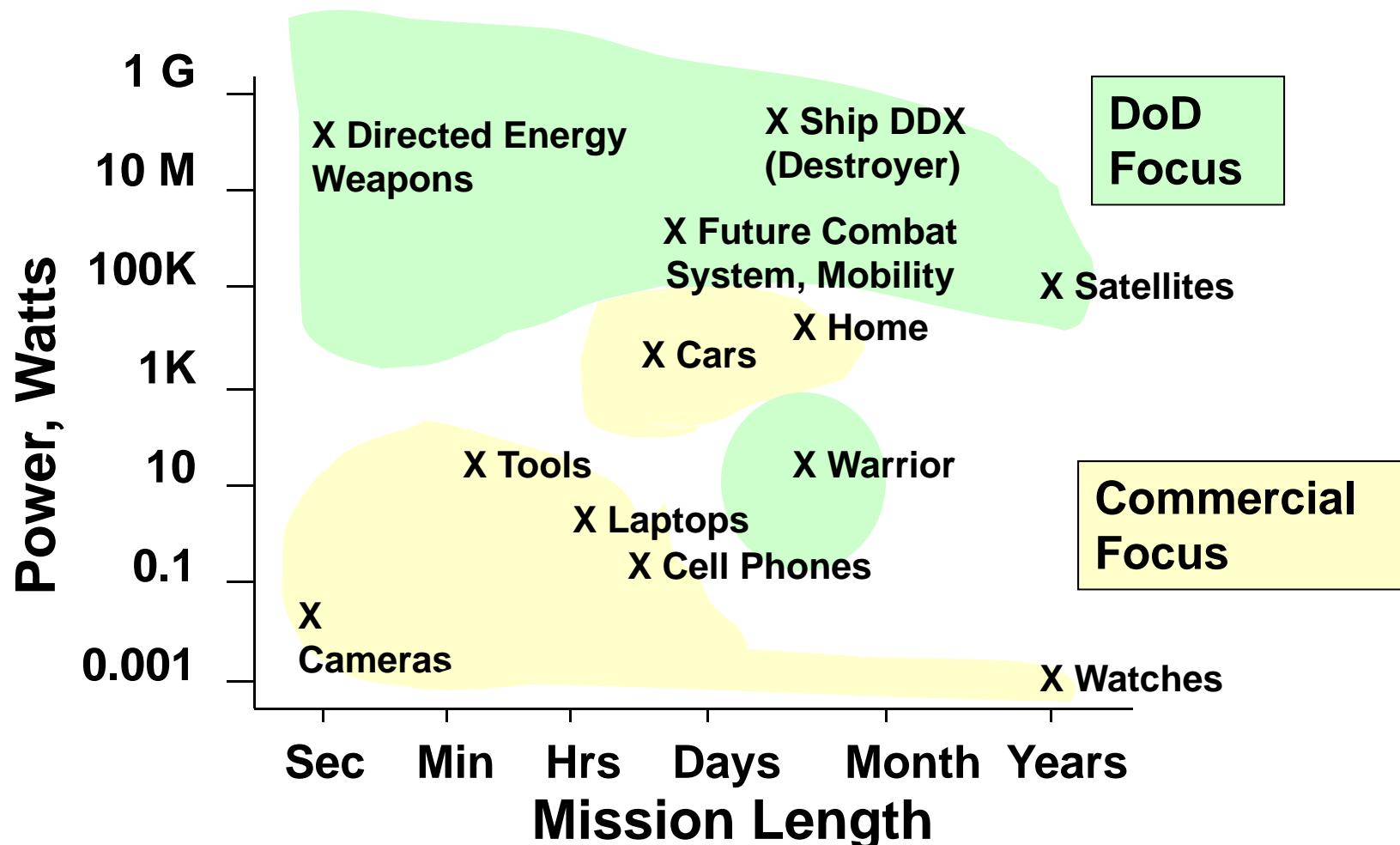
Freeing the Commander from the Fixed Command Post



Disruptive Technology Example: Energy & Power Technologies



Energy and Power Technologies





The Objective Force Army

Today



*~100 lb.
load*

*From Platforms to
System of Systems*



*70+
tons*



*0
mph*

*C-130-Like
Transportability*

Future Force

*< 40 lb.
effective
load*

Fully networked

*< 20
tons*



*> 40
mph*

Accelerating Transformational Capabilities